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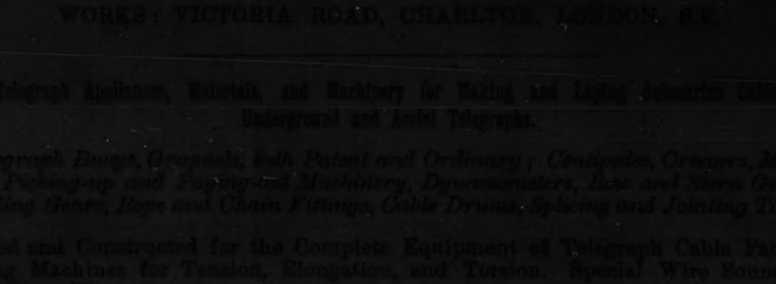

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VOL. XIII.—No. 315.

ESTIMATES FOR ELECTRIC LIGHTING INSTALLATIONS.

WE have lately come across a statement, issued some time during last month, presumably to the shareholders of a well-known company, and, probably, concocted by its directors. It is found, according to this circular, that on the probable consumption, in a *given locality* (the italics are our own), a good profit may be made from private lighting alone, even at a price equivalent to that of gas at 3s. per 1,000 cubic feet, and, although the mains be spread in anticipation of a steadily growing demand, over a very much larger area than is at first required. The installations are supposed to be made in London districts, and the working expenses include, in each instance, £1,000 per annum for administration charges over and above the separate maintenance of the station (which comprises rent, taxes, rates, superintendence, labour, and material), and a very full percentage for depreciation. The figures contained in the circular we reproduce, and doubtless they will be closely scanned by certain of our readers. It is said that the estimates have been prepared by actual tenders for the different classes of work and material required, and, as regards revenue, by a house to house canvass in the streets first to be supplied. Also, that the very best material, together with *duplicate* machinery, is provided for throughout these calculations, which also include a complete system of accumulators which are added to prevent any possible cessation of the electrical supply. On a yet larger scale, says the circular, the cost and expenses would, of course, be relatively less, so that either lower prices could be charged or higher dividends earned; and, satisfactory as the following results are, they only represent the minimum, as neither arc lighting nor the transmission of power are dealt with.

"Installation of 6,000 incandescent lamps, each of 20-candle power, to burn 1,500 hours per annum, and at only 25 per cent. above the charge for gas—a price readily obtainable in most better class residential districts—being indeed an economy when the saving in decorations, &c., is taken into account.

Capital expenditure	£28,463
Working expenses and depreciation	£6,234
Gross income	10,500
Revenue available for dividend	£4,266 = 14·98%.

"Installation of 10,000 lamps under the same conditions:—

Capital expenditure	£50,000
Working expenses and depreciation	£8,730
Gross income	17,500
Revenue available for dividend	£8,770 = 17·5%.

"Installation of 10,000 lamps at ½d. per lamp per hour:—

Capital expenditure	£50,000
Working expenses and depreciation	£8,730
Gross income	15,625
Revenue available for dividend	£6,894 = 13·78%."

ELECTRO-MOTORS.

ELECTRO-MOTORS of small dimensions have not hitherto, with one or two exceptions, shown the efficiency which might have been expected of them. It is with no little surprise, therefore, that we read in our bright contemporary the *English Mechanic*, that an improved electro-motor has been devised by Dr. Austin Meldon, of Dublin, which creates the largest amount of driving power with the least expenditure of electrical force. The armature of the new machine is formed by joining together two 15-inch solid pulley wheels with seven flat bars of iron, each bar being 24 inches long by 3 inches wide and 1½ inches thick, and the bars are laid upon gutta-percha, copper bolts being used to fasten them to the wheels. A shaft of 1½-inch steel passes through the centre, and the whole is supported by a hard-wood frame, stayed with iron. Each side of the frame where the shaft emerges therefrom is supplied with an ivory commutator, the one on the right having three, and the other, four brushes, each of which communicates with a magnet. Attached to the frame are seven electro-magnets; the three larger ones being made of 2-inch soft iron, and wound with No. 14 wire, without bobbins, and the other four of 1½-inch iron, and wound with No. 11 wire. The total weight, as at present constructed, is a little over 3 cwt. The first trial of the motor took place in July last, in a boat 22 feet long and 5 feet beam; and the battery used on the occasion consisted of 36 cells of bichromate of calcium, with zincs 6 inches by 4 inches, and carbons 6 inches by 5 inches. Half of the cells passed through a commutator into one set of magnets (the whole charge going into one magnet at a time), and the remainder of the cells through the other commutator into the second set. The great utility of this arrangement was experienced during the trip, as when all the cells were made use of the boat went at full speed, but when only one commutator was employed half speed was obtained, and on a long trip the second battery could be recharged. The motor is capable of making about 900 revolutions a minute, but this in the trial trip was reduced to 400, when the boat went over, with a slack tide, nine miles in a little more than one hour, a single mile having been accomplished in seven minutes, and subsequently, when the tide was more favourable 11 miles were gone over in an hour. A little over two horse-power has been registered from only 24 cells. Owing to the small size of the launch, the battery, which was placed in the forward portion of the boat, 18 cells being arranged on each side, occupied so much space that there was only room left for four persons to sit with any degree of comfort, and, consequently, the inventor was obliged to abandon the idea of working his motor with a battery; but, judging by the actual result obtained, he is confident that with *two* storage cells of an accumulator, he could easily obtain a speed of over 11 miles an hour.

The advantages claimed for the motor over a dynamo are—1st. Only $\frac{1}{10}$th of the battery power is required to obtain a single horse-power; 2nd. As there is no dead centre it will start instantly, and there is therefore no loss of power; 3rd. The whole force of the battery passes into one magnet at a time, so that very little power is required.

We should be pleased to learn further particulars of this remarkable apparatus, and also of the methods of testing adopted to show its superiority over electromotors already well known. We should imagine that the third claim is a positive disadvantage. Perhaps our correspondent Mr. Toynbee could make a few pointed comments on this matter?

So far as we can see, there is nothing new in Dr. Meldon's arrangement, and we are afraid that his apparatus is merely a reproduction of very old ideas. We cannot see the economy of the inventor's proposition in advocating the use of two cells only of a secondary battery. Perhaps he will favour us with technical details of the results he has hitherto attained.

DE LA QUESTION DES ANTÉRIORITÉS DANS LA DÉCOUVERTE DU TÉLÉPHONE. Th. Du MONCEL.*

(A COMMUNICATION).

I CANNOT refrain from expressing my admiration of the disinterested devotion, for a man "so modest and so intelligent as Mr. Bell," exhibited by Comte du Moncel in his persistent efforts in claiming for Mr. Bell the honour of being the true inventor of the telephone, nor can I refrain from expressing my firm conviction that he has drawn his conclusions from false premises, or from not having before him all the facts necessary to arrive at a just appreciation of the subject matter. I shall endeavour, by extracts from official documents, to show wherein the premises upon which Comte Du Moncel has based his arguments are erroneous, but before I enter upon that matter I take occasion to make a few comments upon certain remarks made by him in which he attributes to honourable men unworthy motives, and casts a slur upon the judiciary of the United States, and upon the American system of granting patents for inventions. Comte du Moncel complains that American "speculators" and inventors are using efforts in a bad cause. Comte du Moncel certainly did not well weigh his words when he called honourable men "speculators," because they have appealed to the legal tribunals in defence of what they believe to be their rights. Is an inventor to be accused of attempting to rob another inventor, because he asks the tribunals of his country to decide who is the prior inventor of a certain instrument? Comte du Moncel is in error in saying that great pecuniary interests are involved in the annulment of Bell's patent. The legal contest in the United States Patent Offices and Courts is not to procure the annulment of Bell's patent, but it is to obtain a judicial decision as to who is the first inventor of the instrument in question. I admit that great pecuniary interests are involved in that question, but not in the sense expressed by Comte du Moncel; the great pecuniary interests involved are those of the honourable men (perhaps Comte du Moncel would call them speculators) who have invested a hundred million of dollars in purchasing and exploiting the Bell patents. Will anyone hold that, because of this enormous expenditure, the Bell patent is to be sustained, and another inventor, whose priority of the invention has been judicially affirmed, is to be robbed of his invention and any benefits he may be able to derive from it? Is it fair and honourable to accuse this inventor of advocating a bad cause and of attempting to rob another, because he and those who have purchased his invention and patents are using their undeniable right to make a profit out of it?

It is true that several appeals from the decisions of the Patent Office have been filed—one by Bell against the decision in favour of McDonough and one by each of the three other claimants, viz., Edison, Gray and Dolbear, against the several decisions in favour of Bell.

I now take up the question at issue—the priority of the invention of the telephone—and I hope the documentary evidence which I shall adduce will satisfy Comte du Moncel that he has based his argument on false premises, and consequently that his conclusion, that priority of the invention is due to Mr. Bell, is wrong.

In a letter signed by Th. du Moncel, published in the REVIEW on the 25th February, 1882, the writer says: "It seems to me that, in the eyes of any impartial man, the invention belongs to the person who has been the first to make it known to an authorised patent administration." This is the very kind of evidence I produce to establish the fact that Bell was not the first inventor of the speaking telephone; and the same evidence will prove that the premises, viz.: Bell's United States patent of 14th February, 1876, relied upon by Comte du Moncel to prove that Bell was the first inventor, fail totally to sustain his conclusions. Bell's specification, filed February 14th, 1876, begins thus: "Be it known that I, Alexander Graham Bell, of Salem, Massachusetts, have invented certain new and useful improvements in telegraphy, of which the following is a specification."

It is to be observed that Bell describes improvements in *telegraphy*; he does not, in any part of the specification, mention the word telephony, or refer to in any manner the transmission of articulate speech, and I invite Comte du Moncel to point out in that specification any mention of or reference to any intention even of Mr. Bell to describe any instrument by which he says articulate speech can be transmitted.

After describing various ways of causing sounds or musical notes at the receiving end of a circuit, and how "the duration of the sounds may be used to indicate the dot or dash of the Morse alphabet," he proceeds to write, "I desire here to remark that there are many other uses to which these instruments may be put, such as the simultaneous transmission of musical notes, differing in loudness as well as in pitch, and the telegraphic transmission of noises or sounds of any kind." The transmission of articulate speech is not mentioned as one of the uses. Is it possible that any one would believe that Bell would not have stated, among these uses, that of the transmission of articulate speech, if such had been the fact, or even if he faintly hoped or expected that his invention would produce that effect which Comte du Moncel writes "has been the admiration of the whole world." The absence of all mention of or reference to such a use of his invention is proof conclusive that Bell did not intend it for such a purpose.

The only instrument described in Bell's patent of February 14th, 1876, for which any pretence can be se up that it is a talking telephone, is shown in fig. 19 of the drawings accompanying the patent, of which the following is the description :—

"The armature A, is fastened loosely by one extremity to the uncovered leg, *h*, of the electro-magnet, E, and its other extremity is attached to the centre of a stretched membrane, *n*. A cone, C^2, is used to converge sound vibrations upon the membrane. When a musical note is made in the neighbourhood of the membrane, *n*, it is set in vibration, the armature, A, is forced to partake of the motion, and thus electrical undulations are created upon the circuit, G, B, E, W, E^1, G^1. The armature, A^1, is thus thrown into synchronous vibration with the armature, A, emitting a musical note of similar pitch to that which originated the vibration of armature A."

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* *La Lumière Electrique*, 24th November, 1883.

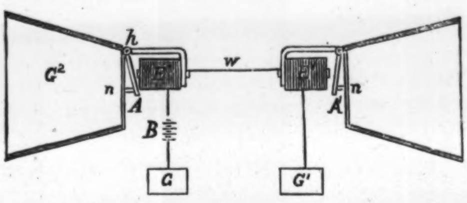


Fig. 19.

No intimation is given here, or in any other part of the specification, that by such an instrument articulate speech could be transmitted. Is it possible to believe that Bell would have omitted all reference to articulate speech if he had any idea that his invention would transmit articulate speech?

Comte du Moncel writes: "il faut, en vérité, une grande dose de mauvaise volonté ou des intérêts bien puissants pour avoir voulu reléguer M. Bell dans la catégorie des inventeurs de second ordre qui ne font que perfectionner les inventions."

Without any "mauvaise volonté ou des intérêts bien puissants," I respectfully submit to all impartial minds that the documentary proofs above submitted, in regard to Bourseul's and Reis' inventions, coupled with the fact stated by Mr. Bell, that he had consulted publications describing these instruments before he had applied for his patents, proves conclusively that Mr. Bell must be placed in the category of inventors of the second order, who have only improved prior inventions.

Mr. Bell, in his lecture delivered before the Society of Telegraph Engineers in London, October 31st, 1877, said: "The results of trials with this instrument, however, were unsatisfactory and discouraging. My friend Mr. Thomas A. Watson, who assisted me in this first experiment, declared that he heard a *faint sound* proceed from the telephone at his end of the circuit, but I was unable to verify his assertion." Now, certainly it cannot be claimed that the "*faint sound*" heard by Mr. Watson was articulate speech; and, further, Mr. Bell, in his disclaimer to his English patent, filed 13th February, 1878, disclaimed this device, because "such a membrane is of small utility."

Can it be supposed for one moment that Mr. Bell would have made such a statement, if by such an instrument articulate speech had been or could be transmitted by it? The supposition is absurd.

The conclusion which every honest mind must draw is that Mr. Bell's patent of February 14th, 1876, does not describe any instrument capable of transmitting and reproducing articulate speech.

Had Mr. Bell at that time invented a speaking telephone, can anyone believe that he would not have described it in his specifications? In fact, Mr. Bell in that specification does not make any allusion even to having made a speaking telephone, and it is incumbent on those who set up that specification as evidence that Bell was the inventor of such an instrument to point out what part of the specification and what drawings in it show such an instrument, and I hope Comte du Moncel will favour the scientific world by pointing out that part of the specification, upon which he relies so confidently, to prove that Bell was the inventor of the speaking telephone.

I will now produce documentary evidence from the United States Patent Office, which proves conclusively that on the 14th February, 1876, the same day on which Bell filed his application for his patent, there was placed on the files of that Patent Office an application for a patent which describes a perfect speaking telephone, and I respectfully ask Comte du Moncel to examine carefully the specification and drawings accompanying the specification, the perusal of which cannot fail to convince him that his opinion of Gray's invention published in the first edition of "Le Téléphon" is the true one, and that he will, in justice to Mr. Gray, repeat the sentiments he expressed in his letter published in the Review of 18th February, 1882, viz., "I should be very sorry for my name to be quoted in support of an injustice, because I was in want of exact information."

Gray's Specification, Filed February 14, 1876.

To all whom it may concern: Be it known that I, Elisha Gray, of Chicago, in the County of Cook, and State of Illinois, have invented a new art of transmitting vocal sounds telegraphically, of which the following is a specification.

It is the object of my invention to transmit the tones of the human voice through a telegraphic circuit, and reproduce them at the receiving end of the line, so that actual conversations can be carried on by persons at long distances apart.

To attain the objects of my invention, I devised an instrument capable of vibrating responsively to all the tones of the human voice, and by which they are rendered audible.

In the accompanying drawings I have shown an apparatus embodying my improvements in the best way now known to me; but I contemplate various other applications, and also changes in the details of construction of the apparatus, some of which would obviously suggest themselves to a skilful electrician, or a person versed in the science of acoustics, on seeing this application.

FIG. 3.

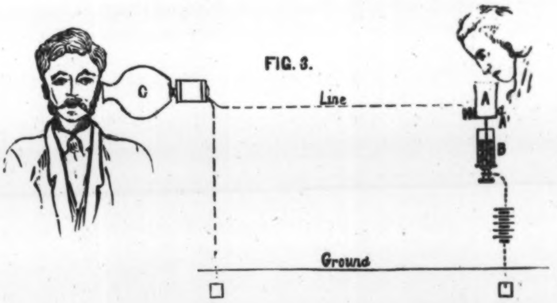


FIG. 1.

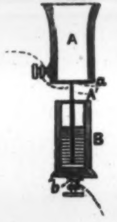


FIG. 2.

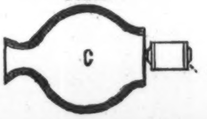


Fig. 1 represents a vertical central section through the transmitting instrument;

Fig. 2, a similar section through the receiver; and

Fig. 3, a diagram representing the whole apparatus.

My present belief is that the most effective method of providing an apparatus capable of responding to the various tones of the human voice is a tympanum, drum, or diaphragm stretched across one end of the chamber, carrying an apparatus for producing fluctuations in the potential of the electric current, and consequently varying in its power.

In the drawings, the person transmitting sounds is shown as talking into a box or chamber, A, across the outer end of which is stretched a diaphragm, *a*, of some thin substance, such as parchment or gold-beaters' skin, capable of responding to all the vibrations of the human voice, whether simple or complex. Attached to this diaphragm is a light metal rod, A^1, or other suitable conductor of electricity, which extends into a vessel, B, made of glass, or other insulating material, having its lower end closed by a plug, which may be of metal, or through which passes a conductor, *b*, forming part of the circuit.

This vessel is filled with some liquid possessing high resistance, such, for instance, as water, so that the vibrations of the plunger, or rod, A^1, which does not quite touch the conductor, *b*, will cause variations in resistance, and consequently in the potential of current passing through the rod, A^1.

Owing to this construction, the resistance varies constantly in response to the vibrations of the diaphragm, which, although irregular, not only in their amplitude, but in rapidity, are nevertheless transmitted, and can consequently be transmitted through

> a single rod, which could not be done with a positive make and break of the circuit employed, or where contact points are used.
>
> The vibrations thus imparted are transmitted through an electric circuit to the receiving station, in which circuit is included an electro-magnet of ordinary construction, acting upon a diaphragm to which is attached a piece of soft iron, and which diaphragm is stretched across a receiving vocalizing chamber, *c*, somewhat similar to the corresponding vocalizing chamber, A.
>
> The diaphragm at the receiving end of the line is thus thrown into vibrations corresponding with those at the transmitting end, and audible sounds or words are produced.
>
> The obvious practical application of my improvement will be to enable persons at a distance to converse with each other through a telegraphic circuit, just as they now do in each other's presence, or through a speaking tube.
>
> I claim as my invention the art of transmitting vocal sounds or conversations telegraphically through an electric circuit.

I respectfully submit that this is the first description on record in any patent office of an articulating telephone which transmits spoken words by means of electricity.

Comte du Moncel, in his paper, says: "Le véritable inventeur, selon nous, est celui qui a reconnu le principe servant de base aux effets téléphoniques et qui a combiné le premier, pour produire les courants ondulatoires et traduire leurs effets par des sons perceptibles à l'oreille." And, further, he says; "Pour nous, qui restons toujours dans l'intime conviction que l'invention du téléphone *réside entièrement* dans la découverte du moyen de rendre l'intensité du courant électrique fonction de l'amplitude et de la forme des vibrations sonores, de la découverte des courants ondulatoires." And, further, he says: "Pour nous, le véritable inventeur est celui qui rend pratique une invention et qui obtient des résultats *constants* basés sur des principes raisonnés."

Does not Gray's specification fulfil all the conditions required by Comte du Moncel to make a speaking telephone?

Does not Gray's transmitter "produce fluctuations in the potential of the electric current, 'which could not be done with a positive make and break of the circuit,'" as stated in the specification?

The specification of Gray says that by his instrument "actual conversation can be carried on by persons at a long distance apart." Now in Bell's specification there is a total absence of any reference to any such results obtainable by his instrument described in his patent of February, 1876.

I now offer documentary evidence of another instrument, which Comte du Moncel says: "Il est certain qu'un pareil système renferme en lui les éléments nécessaires pour la reproduction de la parole;" and, also, "Il aurait donc été possible avec ce système d'obtenir des courants ondulatoires et par conséquent la reproduction de la parole." The documentary evidence is the specification filed in the United States Patent Office by J. W. M'Donough on 10th April, 1876.

It is unnecessary here to reproduce that specification and the drawings, because they have been frequently published in the REVIEW, notably on 25th Feb., 1882, and also in *La Lumière Electrique.* Comte du Moncel asks me why I have fixed the date of this invention to be the 10th April, 1876? The answer is very simple: because I had no evidence, documentary or other, of any prior date of the invention, and also because Bell's specification of February 14th, 1876, did not describe any instrument whereby articulate speech could be transmitted to a distance by means of electricity, and that evidence was sufficient to prove that McDonough had invented a speaking telephone before Bell. We have now, however, the documentary evidence of the United States Patent Office, in the decision of that office, "that McDonough's invention embraced a telephonic receiver, consisting of the combination in an electric circuit of a magnet and a diaphragm supported and arranged in close proximity thereto, whereby sounds thrown upon the line may be reproduced accurately as to pitch and quality." The parties who contested this were Bell, Edison, Gray and Dolbear, and May, 1875, was fixed by the Patent Office as the date of McDonough's invention, and "priority of invention was awarded to him." Comte du Moncel expresses his anxiety to know how the experts of the Patent Office fixed the month of May, 1875, as the date of the invention, without naming precise day, which leads him to suppose that the decision was arrived at by the testimony of witnesses. It was upon the testimony of a great number of witnesses, who, on oath, stated they had themselves talked through instruments made by McDonough in May, 1875. The witnesses were not experts in matters of invention, and their evidence was confined to actual facts known to them. Surely the decision of the United States Patent Office ought to be satisfactory to Comte du Moncel.

Comte du Moncel says the receiver of McDonough is analogous to that of Bell; that is, a horseshoe magnet having a helix on it in front of a circular diaphragm. This is correct; but McDonough's appears in his specification of 10th April, 1876, but that of Bell's does not appear until December 9th, 1876, in his English patent of that date. I am inclined to think that Comte du Moncel has been led into error by supposing that device to be in Bell's first patent of February 14th, 1876. He will see, however, upon examination that in this device McDonough had anticipated Bell by eight months.

In regard to the undulatory current, it is certain that Bell was not the discoverer—that discovery was made by Faraday; at the same time, it is true that *documentary* evidence, that is Bell's patent of February, 1876, shows that Bell used the undulatory current for telephonic purposes. We have, however, a judicial decision, that of the United States Circuit Court, in a suit of Bell against Spencer, which is in these words:—

"The invention of Bell is not anticipated by the apparatus made by Reis, of Germany, in 1860, and described in several publications before 1876, as that apparatus could only act as a transmitter of electrical undulations, and not as a receiver."

It is well known that the Reis box transmitter is well adapted to produce undulation of the current and reproduces speech when any good receiver is used.

It appears, then, that the Court sustained Bell's patent solely on the ground that Reis had not invented, in the opinion of the Court, a good receiver.

It is, however, a well-established fact that the Reis instruments did reproduce articulate speech, a fact demonstrated in court in May, 1882, before Mr. Justice Fry.

The Bell English patent of 9th December, 1876, is the first documentary evidence that Bell claimed to have invented a speaking telephone, which consisted of an iron plate held down all round its edge substituted for the gold-beater's skin.

The United States patent for this device was filed on 30th January, 1877. The claim of Bell to this device has been declared void because the same device was described in McDonough's specification filed on 10th April, 1876.

Before all these claimants to be the inventor of the speaking telephone, I agree with Comte du Moncel in placing Charles Bourseul as the *first* inventor, as appears from a lecture read before the Electrical Society of Frankfort. The following passage, quoted from the lecture, will be read with interest: "If we agree to call the true inventor that man who is the first to conceive clearly a new idea, and who tells us how this idea can be carried out in practice, then the telephone was invented in 1854 by Charles Bourseul, a Frenchman, and about that time a soldier in the African army." We learn further from the same source that the invention had been communicated in 1854 to the French Academy, and that more or less detailed descriptions of it went the round of the German papers of that period. Notable in this regard is one article which appeared on the 28th September, 1854, in the *Didaskalia*, a supplementary paper to the *Frankfurter Journal*, which sets forth the very gist of the invention so clearly, that, in spite of its ancient date, a short abstract from this paper may be interesting to our readers. "An electric current passing through a wire transforms a piece of soft iron into a magnet. If the current ceases the magnetism also ceases. This electro-magnet can be made to alternately attract and release a movable plate, which in its to-and-fro movements produces the conventional telegraphic signals. Now, it is also known that all sounds which reach our ear are produced by vibrations in the air, and that the infinite variety of sounds depends solely on the speed and magnitude of these sound-waves. If, now, a metal disc could be invented which would be flexible enough to reproduce all the sound-waves transmitted to it by the air, and if that disc could be connected to an electric circuit—such a way that in conformity with the vibration of the air it would start and interrupt the current—then it would also be possible to cause a similarly-constructed metal disc, in electrical connection with the first, to repeat all the movements of it, and the effect would be the same as if one had spoken directly against this second disc—that is to say, the ear would be affected in the same manner as if it heard the speech directly through the first metal diaphragm."

I submit that the above description is that of a telephone identical with that of McDonough's, heretofore known under the name of Bell's, and I certainly expect Comte du Moncel to use his pen in support of the just cause, viz., that of Bourseul's claim to be the first inventor of a speaking telephone.

Are not the following facts clearly established by the documentary evidence submitted above :—

1.—Bell did not discover the undulatory current, but Faraday did.

2.—Bell was not the first to use an undulatory current in a speaking telephone, but Reis did in 1861-62, and Gray on 12th February, 1876, and McDonough on 10th April, 1876. Bell, 9th December, 1876.

3.—Bell was not the inventor of a telephone receiver, but Bourseul was in 1854, and McDonough in 1875, and Gray in February, 1876, several months before Bell's patent of 9th December, 1876.

That the so-called Bell telephone was the first instrument of the kind introduced to the public by means of the indefatigable exertions and great wealth of Mr. Gardiner G. Hubbard, father-in-law of Mr. Bell, is admitted, and both Mr. Bell and Mr. Hubbard have been amply repaid by the public both in Europe and America, and in this latter country there has been invested in companies to work the Bell telephone nearly one hundred millions of dollars (twenty millions sterling), of which Mr. Bell is known to have received over four millions of dollars.

Surely this is remuneration enough for having *introduced the telephone to the public*, and it certainly is not just that to him should be accorded the *honour* of being the *first inventor* of the telephone, thus depriving the true inventors of the honour due to them for their scientific discoveries.—*Palmam, qui meruit, ferat.*

W. C. BARNEY.

Dec. 3rd, 1883.

THE CANARY ISLANDS CABLE.

WE read the following in *El Progreso* of Madrid :—

"A great scandal.—This consists in inviting tenders for laying a cable to the Canary Islands, without first having taken the necessary soundings, thus exposing the Public Treasury to serious losses, and giving foreign countries a very poor idea of the foresight of our Government and of the ability of the higher officials of the Telegraph Administration.

"What has happened our readers may gather from the following paragraphs, which we copy from *El Liberal*, of Las Palmas (Gran Canaria), and is the result of the absurd conditions of the concession for the cables signed by the Ex-Director of Telegraphs, Don Candido Martinez.

"A very severe minister would perhaps exact the due of responsibility from Don Candido Martinez, Don Luis del Rey, the present Director of Telegraphs, Don Juan Ravina, commissioned for the laying of the cable, and the Council of higher officials who approved of the specification to which we refer.

"We do not pretend to do so much, but we must request Senor Moret to proceed energetically to remedy the evil, if there be still time, and to reorganise the Telegraph Administration in such a manner that there cannot be a repetition of scandals of such a magnitude and nature.

"Our esteemed colleague writes as follows :—'By one of those incomprehensible anomalies unexplainable in any other nation, the adjudication was announced, and the conditions to be fulfilled by the contractor published, without the Working Commission having first studied, as they ought to have done, the route to be followed by the cable—to secure it being laid on a firm and safe bottom, thereby preventing, as far as human foresight can, any breaking or deviation, to which dangers submarine cables are frequently exposed.

"'With the intention of remedying this carelessness the *Dacia* and *International* left the Bay of Cadiz, following different courses in their route towards these islands, to study, as they have indeed studied, with the aid of all the powerful means known at present to science, the configuration and component parts of the bottom over the whole extent of the water by which the Atlantic separates Europe from these islands.

"'The result of this lengthy and conscientious study has established by irrefutable evidence that between Cadiz and Teneriffe has been found a very uneven bottom, intersected with valleys and mountains, showing sometimes a depth of 49 fathoms, and not far off 1,830 fathoms, thus proving the existence of deep and dangerous holes, found during the sounding of the bank, now for the first time discovered, and which has received from its learned explorers the name of "Dacia Bank." In the same route they also came across an immense bank of coral in full growth, which would not only cut the cable laid over it, but, growing and spreading in all directions, would clutch it in its inflexible and capricious arms, stripping off its cover, and frequently interrupting telegraphic communication.

"'The bottom was also found to contain large veins of manganese, which offer new dangers to the cable through chemical action. The company therefore intends to land the cable on the island of Lanzarote, which, as we all know, is the first island sighted, coming from Cadiz, following afterwards the route so successfully explored by the *International.*

"'This landing might be effected with great advantage in the calm waters of the Rio Straits, between Graciosa and Lanzarote. From that point two branch lines would then be laid, one direct to Teneriffe and the other to Gran Canaria, without interfering with the line already agreed upon, and which has to connect these two latter islands between themselves.

"'We hope, therefore, that the worthy persons in charge of an undertaking which should make its mark in the history of electrical progress of this century, in laying the cable, will follow a track, not as projected by negligence and want of foresight, but as indicated by public convenience, the interests of the company, and the verdict of science.'—VOLTA."

Gas *v.* Electric Lighting.—About a fortnight ago a gas explosion occurred at Nine Elms Station, on the London and South-Western Railway, whereby an employé named Robert Lukey was seriously injured. It appears that he went under one of the locomotives with a lighted taper, to turn on the gas at the meter, from which, by means of a gutta percha tube, gas is communicated to the rest of the carriages, when he was suddenly thrown backwards by a terrific report. It was then discovered that the gas had not been turned off, and hence the explosion. Lukey was at once taken to St. Thomas's Hospital, when he was found to be fearfully burned about the face and arms, and will probably lose his sight. The moral of this is, use the electric light.

TELPHERAGE.

UNDER the designation of "telpherage" Prof. Fleeming Jenkin, in conjunction with Profs. Ayrton and Perry, has devised a system by which the transmission of vehicles by electricity to a distance, independently of any control exercised from the vehicle, is effected. The new system, although it has been tried experimentally in a thoroughly practical shape, and the details of which have been covered by a large number of patents, has not yet been brought to that stage of development which the inventors consider sufficient to justify the scheme being brought prominently to public notice, it being wisely considered advisable to postpone the introduction of the system until every little point of detail has been carefully and thoroughly worked out.

Through the kindness of Prof. Ayrton we have recently had an opportunity of inspecting the works of the "Telpherage Company, Limited," at Weston, near Hitchin, where experiments are being conducted on a large scale, with the object (as before stated) of thoroughly working out all necessary details.

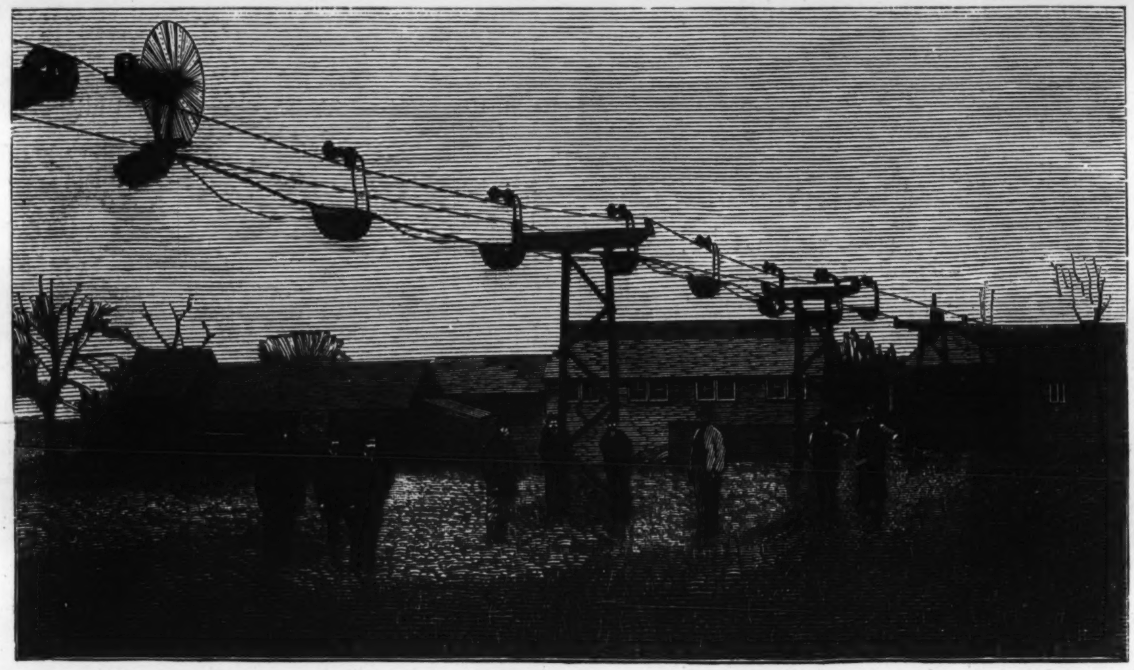


FIG. 1.—CROSS OVER PARALLEL TELPHER LINE.

In his inaugural lecture at the University of Edinburgh, Prof. Fleeming Jenkin referred to the new system as follows :—

"'The transmission of vehicles by electricity to a distance, independently of any control exercised from the vehicle, I will call Telpherage.' These words are quoted from my first patent relating to this subject. The word should, by the ordinary rules of derivation, be Telephorage, but as this word sounds badly to my ear, I ventured to adopt such a modified form as constant usage in England for a few centuries might have produced, and I was the more ready to trust to my ear in the matter, because the word Telpher relieves us from the confusion which might arise between Telephore and Telephone when written.

"I have been encouraged to choose Telpherage as the subject of my address by the fact that a public exhibition of a Telpher line, with trains running on it, will be made this afternoon for the first time.

"You are, of course, all aware that electrical railways have been run, and are running with success, in several places. Their introduction has been chiefly due to the energy and invention of Messrs. Siemens. I do not doubt of their success and great extension in the future —but when considering the earliest examples of these railways in the spring of last year, it occurred to me that in simply adapting electric motors to the old form of railway and rolling stock, inventors had not gone far enough back. George Stephenson said that the railway and locomotive were two parts of one machine, and the inference seemed to follow, that when electric motors were to be employed a new form of road and a new type of train would be desirable.

"When using steam we can produce the power most economically in large engines, and we can control the power most effectually and most cheaply when so produced. A separate steam-engine to each carriage, with its own stoker and driver, could not compete with the large locomotive and heavy train ; but these imply a strong and costly road and permanent way. No mechanical method of distributing power, so as to pull trains along at a distance from a stationary engine has been successful on our railways ; but now that electricity has given us new and unrivalled means for the distribution of power, the problem requires reconsideration.

"With the help of an electric current as the transmitter of power, we can draw off, as it were, one, two, or three horse-power from a hundred different points of a conductor many miles long, with as much ease as we can obtain 100 or 200 horse-power at any one point. We can cut off the power from any single motor by the mere break of contact between two pieces of metal ; we can restore the power by merely letting the two pieces of metal touch ; we can make these changes by electromagnets with the rapidity of thought, and we can deal as we please with each of one hundred motors without sensibly affecting the others. These considerations led me to conclude, in the first place, that when using electricity, we might with advantage subdivide the weight to be carried, distributing the load among many light vehicles following each other in an almost continuous stream, instead of concentrating the load in heavy trains widely spaced, as in our actual railways. The change in the distribution of the load would allow us to adopt a cheap, light form of road. The wide distribution of weight entails many small trains in substitution for a single heavy train. These small trains could not be economically run if a separate driver were required for each. But, as I have already pointed out, electricity not only facilitates the distribution of power, but gives a ready means of controlling that power. Our light continuous stream of trains can, therefore, be worked automatically, or managed independently of any guard or driver accompanying the train—in other words, I could arrange a self-acting block preventing collisions. Next came the question, What would be the best form of substructure for the new mode of conveyance. Suspended rods or ropes, at a considerable height, appeared to me to have great advantages over any road on the level of the ground; the suspended rods also seemed superior to any stiff form of rail or girder supported at a height. The insulation of ropes with few supports would be easy; they could cross the country with no bridges or earthworks; they would remove the electrical conductor to a safe distance from men and cattle; cheap small rods employed as so many light suspension bridges would support in the aggregate a large weight. Moreover, I considered that a single rod or rail would present great advantages over any double rail system, provided any suitable means could be devised for driving a train along a single track. (Up to that time two conductors had invariably been used.) It also seemed desirable that the metal rod bearing the train should also convey the current driving it. Lines such as I contemplated would not impede cultivation nor interfere with fencing. Ground need not be purchased for their erection. Mere way-leaves would be sufficient, as in the case of telegraphs. My ideas had reached this point in the spring of 1882, and I had devised some means for carrying them into effect when I read the account of the electrical railway, exhibited by Professors Ayrton and Perry. In connection with this railway they had contrived means for rendering the control of the vehicles independent of the action of the guard or driver, and this 'absolute block,' as they called their system, seemed to me all that was required to enable me at once to carry out my idea of a continuous stream of light, evenly-spaced trains with no drivers or guards. I saw, moreover, that the development of the system I had in view would be a severe tax on my time and energy; also that in Edinburgh I was not well placed for pushing such a scheme, and I had formed a high opinion of the value of the assistance which Professors Ayrton and Perry could give in designs and inventions.

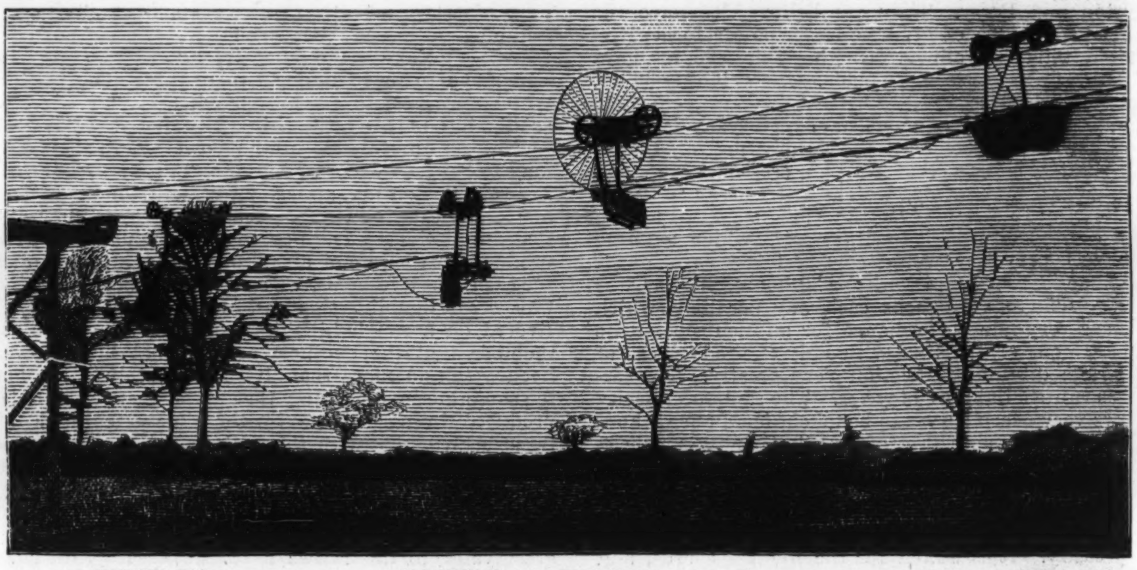


FIG. 2.—CROSS OVER PARALLEL TELPHER LINE. TRAINS PASSING EACH OTHER.

"Moved by these considerations, I wrote asking Prof. Ayrton to co-operate in the development of my scheme, and suggesting that he should join with me in taking out my first Telpher patent. It has been found more convenient to keep our several patents distinct, but my letter ultimately led to the formation of the Telpherage Company (Limited), in which Prof. Ayrton, Prof. Perry and I have equal interests. This company owns all our inventions in respect of electric locomotion, and the line shown in action to-day has been erected by this company on the estate of the chairman—Mr. Marlborough R. Pryor of Weston. Since the summer of last year, and more especially since the formation of the company this spring, much time and thought has been spent in elaborating details. We are still far from the end of our work, and it is highly probable what has been done will change rapidly by a natural process of evolution. Nevertheless, the actual line now working does in all its main features accurately reproduce my first conception, and the general principles I have just laid down will, I think, remain true, however great the change in details may be.

"The line at Weston consists of a series of posts, 60 feet apart, with two lines of rods or ropes, supported by crossheads on the posts. Each of these lines carries a train; one in fact is the up line, and the other the down line. Square steel rods, round steel rods, and steel wire ropes are all in course of trial. The round steel rod is my favourite road at present. The line is divided into electrical sections of 120 feet or two spans, and each section is insulated from its neighbour. The rod or rope is at the posts supported by cast-iron saddles, curved in a vertical plane, so as to facilitate the passage of the wheels over the point of support. Each alternate section is insulated from the ground; all the insulated sections are in electrical connection with one another—so are all the uninsulated sections. The train is 120 feet long—the same length as that of a section. It consists of a series of seven buckets and a locomotive, evenly spaced with ash distance pieces—each bucket will convey, as a useful load, about 2½ cwt., and the bucket or skip, as it has come to be called, weighs, with its load, about 3 cwt. The locomotive also weighs about 3 cwt. The skips hang below the line from one or from two V wheels, supported by arms which project out sideways so as to clear the supports at the posts; the motor or dynamo on the locomotive is also below the line. It is supported on two broad flat wheels, and is driven by two horizontal gripping wheels; the connection of these with the motor is made by a new kind of frictional gear which I have called nest gear, but which I cannot describe to-day. The motor on the locomotive will give as a maximum 1½ horse-power when so much is needed. A wire connects one pole of the motor with the leading wheel of the train, and a second wire connects the other pole with the trailing wheel; the other wheels are insulated from each other. Thus the train, wherever it stands, bridges a gap separating the insulated from the uninsulated section. The insulated sections are supplied with electricity from a dynamo driven by a stationary engine, and the current passing from the insulated section to the uninsulated section through the motor drives the locomotive. The actual line is quite short, and can only show two trains, one on the up and one on the down line; but with sufficient power at the station, any number of trains could be driven in a continuous stream on each line. The appearance is that of a line of buckets running along a single telegraph wire of large size. A block system is devised and partly made, but is not yet erected. It differs from the earlier proposals in having no working parts on the line. This system of propulsion is called by us the Cross Over Parallel Arc. Other systems of supplying the currents, devised both by Profs. Ayrton and Perry and myself, will be tried on lines now being erected; but that just described gives good results. The motors employed in the locomotives were invented by Messrs. Ayrton and Perry. They are believed to have the special advantage of giving a larger power for a given weight than any others. One weighing 96 lbs. gave 1½ H.P. in some tests lately made. One weighing 36 lbs. gave 0·41 H.P.

"No scientific experiments have yet been made on the working of the line, and matters are not yet ripe for this—but we know that we can erect a cheap and simple permanent way, which will convey a useful load of say 15 cwt. on every alternate span of 120 feet. This corresponds to 16½ tons per mile, which, running at 5 miles per hour, would convey 92½ tons of goods per hour. Thus, if we work for 20 hours, the line will convey 1850 tons of goods each way per diem, which seems a very fair performance for an inch rope. The arrangement of the line with only one rod instead of two rails diminishes friction very greatly. The carriages run as light as bicycles. The same peculiarity allows very sharp curves to be taken, but I am without experimental tests as yet of the limit in this respect. Further, we now know that we can insulate the line satisfactorily, even if very high potentials came to be employed. The grip of the locomotive is admirable and almost frictionless—the gear is silent and runs very easily. It is suited for the highest speeds, and this is very necessary as the motors may with advantage run at 2,000 revolutions per minute.

"The suspended rods are not suitable for high speeds. Centrifugal force would cause great strains on them, and the vehicles would be shot up into the air at the points of support. Very high speeds might be attained for light trains with a stiff road, but we are for the present less interested in this application of our ideas. A smaller type of line with ⅝ rods and smaller spans is in course of construction. This will probably soon be extended for a mile or so, now that we have gained some experience on the few spans of this heavier line.

"At present we do not contemplate working lines extending more than five miles from a station, so that in a long continuous line we should require stations at intervals of ten miles. A single station could work, either simultaneously or in succession, a large number of lines radiating from it in many directions.

"I cannot yet enter into questions of cost, and the company is hardly ready to undertake contracts, except perhaps for very simple cases. We have still to elaborate designs for sidings; for loading and marshalling the trains; and we have still to test the arrangements for governing and blocking. We have also to compare different systems of electric propulsion and blocking, and improve the design of many details in construction. All this will take time, but time and thought are all that is required. No new discovery is wanted; no unforeseen difficulty has been met with.

"I am almost afraid to speak of the probable uses to which Telpherage may be put. If I said all I thought, I should be told I was describing an electrical Utopia. The first and most obvious use of a Telpher line is that to which existing wire tramways are already put—namely, the conveyance of minerals or ore from mines to canals, railways, or the sea. The suspended wire rope is specially suited for rocky, uneven ground, and very heavy gradients could be worked. The Telpher line has the following advantages over the present system:—It can go round sharp curves, change the gradient as often as is desired, and be made of any length; any train can be stopped and shunted without stopping the others. If made with no working parts, as in the present example, the permanent way may be left idle for part of the year with no sensible deterioration.

"Mineral traffic of this kind is, however, in my opinion, only one small part of the work which these lines can do. Where railways and canals do not exist, Telpher lines will provide the cheapest mode of inland conveyance for all goods—such as corn, coal, root crops, herrings, salt, bricks, hides, and so forth—which can be conveniently subdivided into parcels of one, two, or three hundredweight. In new colonies the lines will often be cheaper to make than roads, and will convey goods far more cheaply. In war they will give a ready means of sending supplies to the front. Moreover, wherever a Telpher line exists, power is thereby laid on, and this power may be used for other purposes than locomotion—a flexible wire attached to the line will serve to drive a one, two, or three horse engine, which may be used for any imaginable purpose, such as digging, mowing, threshing, or sawing. It is true that in the transmission of the power more than half may be wasted; but the proportion wasted is diminishing yearly, monthly, almost daily, with the growth of our electrical knowledge; and when we remember that by stationary engines in London power can be produced at the rate of about one halfpenny per hour for each effective horse, we shall not be alarmed at the prospect of doubling this cost when the power is delivered on a rough hillside—especially when we remember that the engine receiving that horse-power need weigh no more than 100 lbs. Surely I am not too sanguine in expecting that great changes will be produced in agriculture by these new facilities for transport, coupled with the delivery of power at will from any point of the Telpher road. It must not be supposed that I look on the new Telpher lines as likely to compete with railways or injure their traffic. On the contrary, my feeling is that they will act as feeders of great value to the railways, extending into districts which could not support the cost even of the lightest railway. It is idle to endeavour to foretell the future of any new idea; but this much is certain—a novel mode of transport, offering some exceptional advantages, will be publicly shown on a practical scale to-day."

The three large illustrations which we give are from photographs of the experimental telpher lines erected at the company's works at Weston.

The line shown by figs. 1 and 2 consists of two steel conductors running parallel to each other, and supported at the ends of cross-beams fixed on the top of wooden supports. These steel conductors serve both for the conveyance of the electric current and also as rails on which run the electric locomotive and the skips drawn by the former. One conductor forms the "up" line and the other the "down" line.

The skips are connected to the locomotive and to each other by long wooden draw-rods, so that a train of considerable length, distributed over several spans, can be formed. For the working of the system it is necessary that the length of the train be not less than one span, though it may be extended beyond this to any extent required.

The line, as arranged at Weston, is adapted for working either on the "cross over parallel" or the "series" system. The principle of the first method is explained by fig. 4.

In this fig. f_1, f_2, f_3 represent some of the points of support of the conductors. Each span, both of the up and down line, is insulated from its neighbour in the manner shown in the above figures. But a very much simpler modification, which is now being tried, is shown in fig. 6. The insulation of this simpler form is only good enough for the series system—to be presently described; but its three parts, A, B, and C, correspond with three very much more perfectly insulated and similarly situated parts of the existing post heads suitable for the cross-over parallel system. In this fig. A and B are cast steel supports, bolted down on a wooden block, which latter is itself bolted to the end of the cross-beams before referred to, or this block may be the end of the cross-beam itself. The upper surfaces of A and B are channeled to receive the conductors, W_1 and W_2. These conductors pass one on each side of the cast steel piece, C, and go through holes in the wooden block, being secured in the latter by nuts, as shown. The piece, C, is bolted on the wooden block in a position intermediate between A and B, but is insulated from the two latter. This piece serves as a continuation between the rods, W_1 and W_2, so that the wheels of the locomotive and skips can ride from W_1 to W_2 with regularity and smoothness.

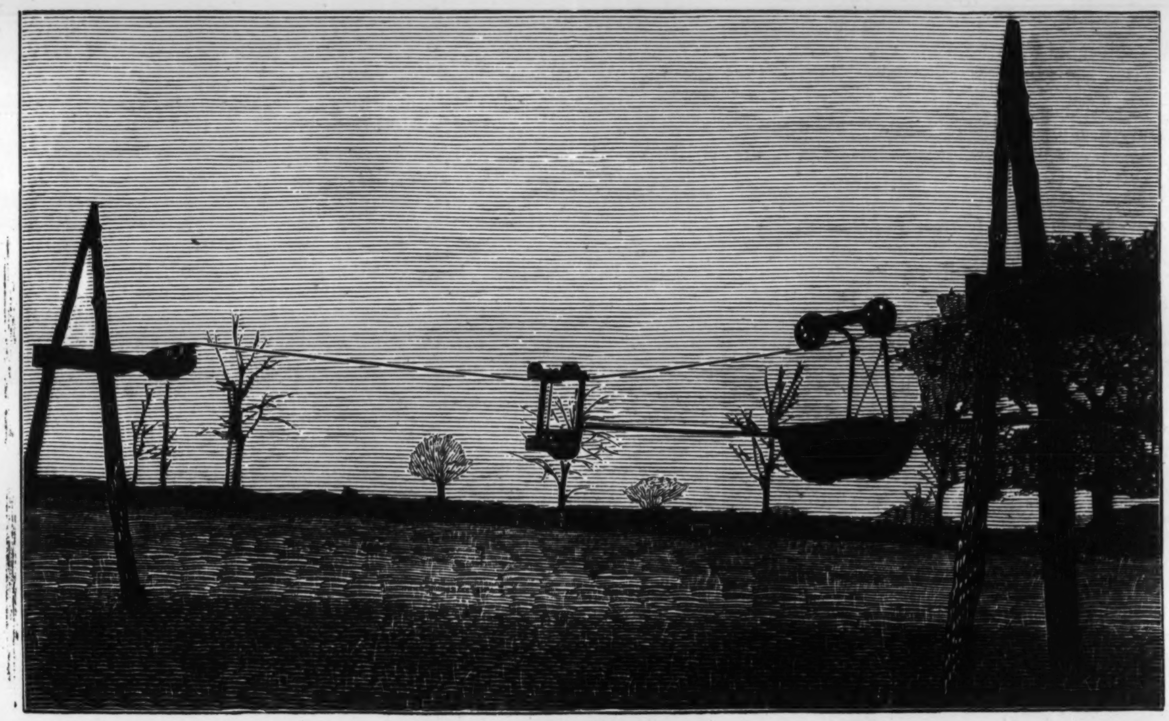


FIG. 3.—SERIES TELPHER LINE.

In the "cross-over parallel" system, shown by fig. 4, the support, A (fig. 6), would be electrically connected to the support corresponding to B at the other end of the cross-beam, whilst B (fig. 6) would be electrically connected to the support corresponding to A at the other end of the cross-beam.

Referring to fig. 4, it will be seen that if one pole of the dynamo be connected with the left hand extremity of the conductor represented by the continuous line, the other pole being connected with the uninsulated line, shown dotted, then supposing the trains, M and N, to be in the positions shown, a portion of the electric current must pass through each train, and by actuating the locomotives in their circuit must put them in motion. The length of the train is very nearly equal to that of an electrical section of the line, and by a special device not yet made public, there is a certainty that there is never any dead point. It must be obvious that the number of trains which can be running on each conductor is not limited to one only.

The "series" system of working, a photograph of which is shown in fig. 3, will be understood from fig. 5, which represents a single conductor. In this method the electrical breaks in the spans at g_1, g_2, g_3, &c., are kept normally closed by means of switches; these switches are opened automatically immediately a train bridges over them, so that the current is caused to pass through the train and thus keep it in motion; immediately that the train has passed over the break the switch of the latter is automatically closed again, either mechanically or electrically, so that the continuity of the circuit is preserved. As in the "cross-over parallel" system, several trains can be running at the same time on the line, and with this system no special contrivance is necessary to avoid a dead point, other than that the train must be longer than an electrical section, so that the box in front is always opened before the one in the rear is closed.

An advantage of the "series" system is, that only one conductor is required as against two in the "cross-over parallel" arrangement; the necessity of having automatic switches, however, must, to some extent, counterbalance this advantage; but, as the two sections of a line are never required to be insulated from one another, except when they are joined by a motor on a train, the total effective resistance of which, including back electromotive force, can never exceed a few ohms, it follows that the insulation between A and B (fig. 6), need not be nearly as perfect as in the cross-over parallel system. Hence the cost of the contact boxes necessary with the series system will probably be more than counterbalanced by the cheapness of the heads of posts possible with this system. It must also be pointed out, however, that by working the series system with a small current and high electromotive force, the waste of power may be made very small indeed. Experiments are being made with motors, producing each 1½ horse-power, working with 500 volts, and requiring a current of two or three ampères only. The use of such a high electromotive force is, however, we think, objectionable, as considerable loss would result in damp weather, unless the insulation of the line were very good. But should there be found difficulty in obtaining this, it is possible in the series system to support the whole top of the post (fig. 6) on a good insulator, which, only having to support the resultant downward thrust, may have high insulation combined with sufficient strength.

The working of the gearing between the electro-motor and the driving wheels is effected by very ingenious arrangements, devised by the three patentees, by which the strain which, in ordinary gearing, is thrown on the rotating axles, as for instance, when two wheels are geared together by belting, is entirely got rid of. One method by which the object is effected is shown by fig. 7. A and B are two wheels which are required to tightly grip the carrying rod, r, between them. On the axles of A and B, two small wheels, a and b, are fixed; these wheels gear by friction with the small wheels, c and d—c being fixed on the axle f, and d sliding loose on it but being prevented from turning by being on a square arbor. The wheel, d, is kept pressed to the left by a strong spiral spring, s, which presses against a collar, e, on the axle, f. It will thus be seen that a and b, and consequently A and B are strongly pressed together against the carrying rod, r, without any frictional strain being brought to bear on the bearings in which the upper ends of the axles, h and j, turn.

The axle, f, or any of the other axles, being geared to the motor, the rotation of the latter will cause the whole frame in which the motor and the gearing is set, to be advanced along the carrying rod, r. The frame itself rests on the carrying rod through the medium of grooved wheels.

The motor being constructed to turn at a very high velocity does not work direct on to the axles, but in one of the locomotives used at Weston the axle, f, has a large bicycle wheel fixed on it (see figs. 1 and 2), and the motor turns this wheel through the medium of antifrictional gearing, arranged very much on the same principle as the gearing shown by fig. 7.

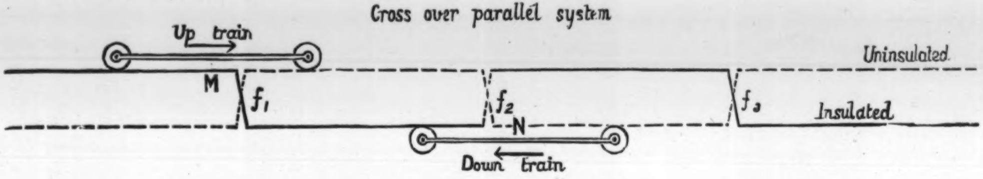


FIG. 4.

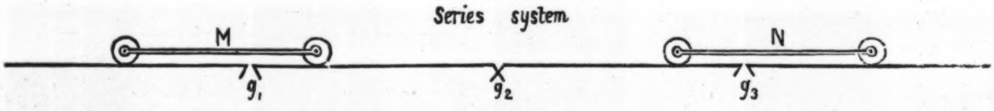


FIG. 5.

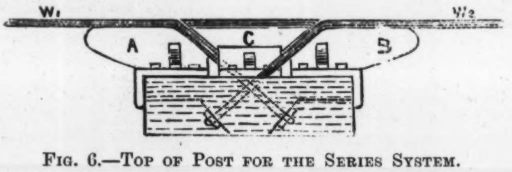


FIG. 6.—TOP OF POST FOR THE SERIES SYSTEM.

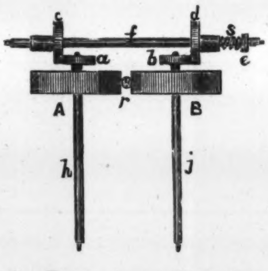


FIG. 7.—RIGHT ANGLE NEST GEARING.

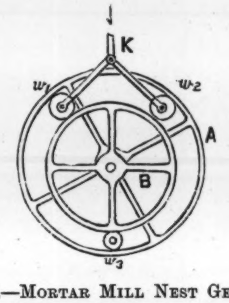


FIG. 8.—MORTAR MILL NEST GEARING.

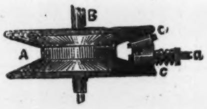


FIG. 9.—RIM GEARING.

Another arrangement of gearing adopted in the small locomotive seen to the left in fig. 2, is shown by fig. 8. A is a crown wheel with a smooth inner rim, and B a smaller wheel with a smooth outer rim. Wheel B is set slightly eccentric to wheel A. Between the rims of the wheels are three small wheels, w_1, w_2, w_3; the latter is fixed on the axle of the electro-motor. w_1 and w_2 are set in two links hinged to a third link, K, which latter is kept pressed forward by a force applied in the direction of the arrow. By this means it is obvious that, owing to the eccentricity of the two wheels, A and B, the three wheels. w_1, w_2, and w_3, must all be in firm contact with the rims of A and B; so that w_3 when turned, must also turn by friction both the wheels, A and B. It must be also obvious that although w_3 is in firm frictional contact with A and B, yet there is no strain whatever on its axle pivots. The wheel B is an idle one and runs freely on its own axle; A is geared through the medium of a long axle (seen in fig. 2) to a set of gearing similar to that shown in fig. 7. Another form of these frictional gearings is adopted in the small locomotive seen in fig. 3. This is shown by fig. 9. A is a wheel with a conical groove in it; this wheel is geared by means of its axle (seen in fig. 3) to gearing similar to that seen in fig. 7. a is the axle of the electromotor; on this axle a cone, c, slides on a square arbor, this cone is kept pressed forward by means of a strong spiral spring. c_1 is a second idle cone placed in the position shown. By this arrangement it is obvious that whilst the axle, a, is firmly geared by friction to the wheel, A, yet there can be no frictional strain on the bearings of a.

To make "telpherage" possible, a light electro-motor of considerable power is necessary; this electro-motor Profs. Ayrton and Perry have succeeded in producing, as a motor constructed on their plan and weighing

96 lbs. only, will give out 1½ horse-power at the rotating spindle.

The difficulty of preventing a train from running into a train ahead has been overcome by Prof. Ayrton and Perry's absolute block system and also by their plan of "governing" the motors so that they run always at the same speed whatever work they have to do, that is to say, whether they are running up hill or down.

The train shown in fig. 1 carries about 18 cwt., or nearly a ton, in addition to the weight of the locomotive and seven skips.

NOTES.

Electric Lighting.—The new Royal Axminster Carpet Factory of Messrs. Woodward, Grosvenor & Co., of Kidderminster, is now lighted by electric light. 100 Swan 20 candle lamps are distributed throughout the building, and the current is supplied by a Crompton self-regulating dynamo. The lamps are mounted under opal glass reflectors, by which arrangement an even distribution of the light is secured. The work has been carried out by Messrs. Holmes & Vaudrey for the Liverpool Electric Supply Company, Limited.

The Imperial Brazilian ironclad *Riachuelo*, building by Messrs. Samuda Brothers, of Millwall, is being fitted with electric light by Messrs. Siemens Brothers & Co. The installation will consist of about 300 high-resistance Swan lamps of 20 candle power, and two search lights in Mangin projectors fitted with inclined hand lamps, each light of the minimum power of 25,000 candles. Both lights can be burnt simultaneously, and will be so placed in the ship that they can completely sweep all round her for protection against night attack. Likewise, there will be two yard arm lights, each consisting of eight 40 candle Swan high-resistance lamps mounted in a concave reflector, with portable leads from a deck connecting box, and arranged to sling from fore or main yard arms on either side of the ship, for use in coaling at night. The dynamos, three in number, are to be Siemens' self-regulating continuous current machines, driven direct by Brotherhood's new engine, with self-adjusting coupling, each dynamo being wound to work either large arc or incandescent lamps. This will, when finished, be by far the most complete installation yet fitted in any *fighting* ship.

The City of Dublin Steam Packet Company, which has obtained the renewal of the contract for the mail service between Holyhead and Kingston, is lighting the mail steamers by electric light. Messrs. Edmundson & Co., of 19, Great George Street, Westminster, and Dublin, are carrying out the work, and are now engaged upon the *Munster*, which will be the first of the vessels to be so lighted.

The Brush Electric Light Company, of Philadelphia, is preparing to put its wires on Delaware Avenue underground. The company has been required to enter bonds, in the amount of $20,000, to keep the avenue in repair.

Aurora, Ill., and Ogden, Utah, are lighted by electric lamps, the power used being that of waterfalls. An electric lighting company proposes to utilize the power of the Genesee Falls at Rochester, N. Y., and is putting in turbine wheels for the purpose.

There are upwards of 360 electric lamps employed in lighting Boston streets, U.S.A., at a cost of 6 cents per night. The average displacement of street lamps by each electric light is 3¼ lamps, which, for 369 electric lights, would make a total of 1,199½ street lamps that have been displaced by electric lights.

The electric light having been adopted by the management of the Gaiety Theatre, Glasgow, for use in all parts of the house, the *Glasgow Herald* of Monday's date says that a large number of gentlemen were invited to see it turned on for the first time, as an experiment, on Saturday afternoon. Two Gramme alternating dynamo machines are used, driven by an engine placed under the pit. Two distinct systems of lighting are used—Swan's incandescent lamps, and several Jablochkoff arc lights. The largest arc lantern is in the ceiling, and contains three lights, each of 1,000 candle power; and four lights of less power are fitted up on the stage, to be used in scenic effects in place of the lime light. The auditorium, passages and crush room are lighted on the Swan incandescent system, supplied by two circuits, one feeding 150 and the other 140 lights. The house, when lighted up, had a capital appearance, and the Swan lamps could hardly be detected from ordinary gas burners. The large arc lantern throws a strong flood of light over the auditorium, and those on the stage will be of great assistance in producing telling effects. The Gaiety is the first theatre which has been fitted with the double system, and the management has every confidence that it will be a complete success, while having the advantage of keeping the house cool and lessening the risks of fire.

According to the *City Press* of Wednesday, the Streets Committee of the Commissioners of Sewers have resolved to recommend that the City be divided into five districts, comprehending the leading thoroughfares, for the purpose of electric lighting, and tenders are to be invited from various companies to carry out the work, which is to be done with as much promptitude as possible. This is in addition to one district for which a company has already permissive power.

We are informed that the Consolidated Electric Company, Limited, has overcome the difficulties attending the storage and portability of electrical energy by the introduction of an accumulator which can be conveniently carried under the seat of a carriage in motion. The apparatus, which was constructed by the Consolidated Electric Company, Limited, for the Provincial "Brush" Electric Light & Power Company, Limited, was used to light up a carriage of Mr. A. de Rothschild's on a test journey on Sunday evening. The light is under the entire command of the occupant of the carriage. An incandescent light is placed in each of the ordinary outside carriage lamps, and one arranged with a small bracket and globe inside. The current is supplied from five cells, containing six metal plates in each, and the battery can be recharged, without disturbing the arrangements, by simply connecting two wires. The whole is contained in a small mahogany case, weighing a little over 1 cwt., and it can be easily removed from the carriage if necessary.

A public meeting of the warehousemen, merchants and tenants whose premises are situated in the central section of Glasgow, was held in the Religious Institution Rooms, Buchanan Street, on Tuesday afternoon, Prof. Simpson presiding. Mr. Charles T. Grant said that the meeting had been called for the purpose of devising the best means of supplying electric light to the district. They had had in their offices between 7,000 and 8,000 people, and every one was ready to take the electric light into their premises. The matter seemed to be that there should be formed a supply association for the purpose of lighting the district with electric light by means of a central station. He and Mr. Turnbull, the engineer, had to some extent gone over the accounts with a view to ascertaining what it would cost to erect a central station. They calculated that a capital of £25,000 or thereabouts would be sufficient and would be capable of giving 10,000 lamps. He found that in the central district of the city, from North Street to Glassford Street, gas last year cost £44,945 3s. If they were charging one penny per night for the electric light in the central district, they would expend about £9,500, and the income would be about £15,258, which was a very creditable margin. A motion that a company should be formed for the purpose of supplying the city with electric light was afterwards adopted by the meeting. After further speaking the meeting separated.

The s.s. *Clan Matheson*, the latest and largest of the Clan Line fleet, made a successful trial trip on Saturday last. The *Clan Matheson* is a vessel of 3,900 tons, dimensions 380 by 43 by 29 feet hold, and will carry close on 5,000 tons of coal and cargo. She is lighted throughout by the Swan electric light, has Sir W. Thomson's compass, and has a magnificent saloon amidships seated for 64 passengers. This is the fourth vessel built by Messrs. Napier, Shanks & Bell for the same owners. A numerous company was on board.

The Leeds Philosophical and Literary Society's Halls have not unfrequently been lighted by electricity, but on these occasions the placing of the steam engine was a question of difficulty, it had either to be stationed inside the building, or in the adjoining street, which necessitated the stoppage of traffic. Messrs. Kingsland and Smith, with the co-operation of the National Telephone Company, overcame the difficulty by conveying, by means of an overhead wire, the current from the Ferranti dynamo, used for lighting the premises of Messrs. Marsh, Jones & Cribb, 48, Bear Lane, 300 yards distant. Sixty-six Swan incandescent lamps were used to illuminate the various parts of the building, and the lighting was very satisfactory, giving brilliancy to the scene, and enabling the party to view with advantage the many scientific and artistic curiosities gathered together for their pleasure.

The *Evening Standard*, on Wednesday evening, published the following telegram from Calcutta, under date of December 5th :—"The opening of the Calcutta Exhibition yesterday took place in the Museum. At the conclusion of the ceremony some person, who has not been discovered, cut off the electric light, leaving the assemblage in total darkness."

Telegraphic Communication between Tonquin and Cochin China.—The Eastern Extension Company, says a daily paper, whose draft contract with the French Government for laying a submarine telegraph cable from Saigon to Haiphong was rejected by the Chamber last Session, is nevertheless to be entrusted with the work of laying that cable, and according to the Bill just laid before the Chamber, undertakes to place Tonquin and Cochin China in direct telegraphic communication within sixty days after the ratification of its contract by Parliament. The reason which induced the Deputies to reject the first contract was that the telegraph line would be in the hands of an English Company. According to the present convention the line is to be worked by the French Government, which is to pay to the Eastern Extension Company during twenty years an annual sum of £10,000 for keeping it in repair.

The Bennett-Mackay Cable.—The agent of the new cable, says the New York *Electrical World*, has been examining the shore at Rockport, Mass., and stated that it has been decided to locate the terminus there at a spot called Loblolly, at the south end of the town.

Brazilian Submarine Telegraph Company, Limited.—This company's cable between St. Vincent and Pernambuco has been repaired, direct telegraphic communication with South America being therefore restored. We have received a copy of the new tariff issued by the company, which contains much useful information, and with which is an excellent map showing the telegraphic connections between Europe and South America.

Edison and Storage Batteries.—We mentioned last month that the Edison Electric Light Company had purchased the right for the Faure-Sellon-Volckmar electric accumulators throughout Germany. Mr. Edison, according to an American contemporary, told a reporter that the statement was untrue, and that in his opinion it was simply a scheme to boom the Faure stock. He said he had no reason to recede from his previous condemnation of alleged storage batteries, but if a good, practical system of storage ever were discovered, he would endorse it and probably use it. He said it is a question of chemistry, not electricity, and that chemists have so far failed to produce any feasible method of storing electricity, even from a scientific standpoint. In spite of Mr. Edison's contradiction, we have good reasons for believing our original information to be true.

The Westinghouse Machine Company, Pittsburgh.—This Company reports a remarkable activity in the demand for its automatic engine. During the month of October the company manufactured and shipped a total of seventy-three engines, representing a product of nearly $50,000. The new orders during the same month aggregated over 2,000-horse power.

Sale of Electrical Plant.—The stock, plant and machinery of the Duplex Electric Light Company will be sold by auction by Mr. Frank Lewis, on the premises, 9, Soho Square, and Black Horse Yard, Rathbone Place, Oxford Street, on Monday, December 10th, 1883, and three following days, at 12 o'clock precisely each day. See our Advertisement columns for other particulars.

Oldham Fine Art and Industrial Exhibition.—In our notice of this excellent exhibition, in our last issue, we omitted to say that, all the electric light cables and wires were supplied by Messrs. W. T. Glover and Company, of Manchester.

The Simplex Electric Light and Plant Company, Limited.—This is the title of a new Company the prospectus of which is advertised this week. The particulars of capital are of course given therein, but not the numbers of the patents which it is intended to purchase for £10,000 in cash and £6,000 in shares of the Company. This is an omision which attracts our notice, and therefore we call attention to our column "New Companies Registered," in which we supply this information. There is another singular feature in this prospectus, it is that notwithstanding Professor Sylvanus Thompson's report on the arc lamp (only) is said to be, "in the highest degree favourable;" the report itself is not given, surely it is a mistake to hide anything relating to this "light" under a bushel. It is usual to invite the public to inspect that which it is asked to buy, but the prospectus before us contains no such invitation, it states, however, that further particulars and information will be furnished on application to Mr. Jacob Williams, at Carlton Buildings, 17, Cooper Street, Manchester. The vending company is named The Protector Lamp and Lighting Company, some particulars of which may be found in our "Official returns" column. The title of "Simplex" is suggestive, and recalls to mind another company the name of which ended with—plex. May, however, the Protector Company protect its "simplex" offspring from the unhappy fate of the ill-starred Duplex.

By the way—what relation does the Protector Lamp and Lighting Company bear to the "Sun Electric Light Company" of Worsley?

A New Electrical Company.—The formation of a company, with a capital of 40 or 50 millions of francs, is talked of, for the object of working the patents of M. Marcel Deprez, for the transmission of power to a great distance, which are the property of a syndicate. The profits from this undertaking would be divided in the following manner:—an interest of 8 per cent. would be, first of all, paid on the capital; the surplus would be divided thus:—70 per cent. to the shareholders and 30 per cent. distributed one-third to Messrs. Rothschild frères and two-thirds to the French syndicate.

Société Internationale des Electriciens.—This Society, formed but a few weeks since, numbers already more than a thousand members, belonging to more than twenty nationalities. The first general meeting took place on the 15th ult., under the presidency of M. Cochery, Minister of Posts and Telegraphs. M. Georges Berger, proposed the division of the technical matter into six sections: 1. Theoretical electricity, electrometry, and lightning-rod; 2. Electrical machines and motors, transmission and distribution of energy; 3. Electric light, the calorific action of the current; 4. Telegraphy and telephony; 5. Railway signals, and electrical chronometry; 6. Electro-chemistry and electro-therapeutics. The Committee to be composed of fifty French members and two members of each foreign nationality, exclusive of the Presidents, Vice-Presidents, Secretaries and Treasurers. The meeting after having carried this proposition as well as a vote of approbation of the statutes, adjourned until December 13th for the election of members of the Committee.

The Manufacture of Incandescence Lamps.—We notice in a monthly contemporary that, Messrs. Woodhouse & Rawson are now making lamps of from 1 to 100-*horse power*, and that they can now turn out from 100 to 1,500, rather a wide limit, lamps per week. We mention these evident slips in order that they may be corrected if it is thought desirable.

A New Electrical Railway.—An electric railway, differing in several respects from ordinary electric railways, has been devised by Mr. F. Hahn Danchell, C.E., and is being exhibited by a working model at the offices of Messrs. Bauer & Co., 6, Union Court Chambers, Old Broad Street. The distinguishing feature in the construction is that the train runs on one rail only instead of two, and it is balanced by another rail overhead which is embraced by pairs of side guide wheels attached to the upper part of the train. The speed attained is very great, and experiments on a much larger scale have already been carried out at Maidstone, which we, some months since, had the pleasure of witnessing.

Society of Telegraph Engineers and Electricians.—The annual general meeting will be held on Thursday, 13th December, for the reception of the annual report and election of council and officers for the ensuing year. The following papers will be read:—1. "On an instrument for measuring the strength of a magnetic field." 2. "On a method of calculating the total horse-power expended in a network of conductors (such, for instance, as a system of street mains)." By J. E. H. Gordon, B.A., member.

Duplex Electric Light, Power, and Storage Company, Limited.—We notified in our issue of November 17th that Mr. Samuel Lovelock, chartered accountant, 19, Coleman Street, had been appointed official liquidator of this company, and we now observe that claims are ordered in to him by December 31st. The hearing takes place on the 14th January, at Vice-Chancellor Bacon's Chambers, Royal Courts of Justice.

Bexhill Water and Gas Company.—An advertisement appears in the *London Gazette* of November 30th, notifying that application is intended to be made to Parliament in the ensuing session for leave to bring in a Bill for the incorporation of a company under the above title, which, among other powers, is to have that of supplying electricity for public and private purposes, to the parish of Bexhill, Sussex.

Westminster District Electric Lighting Company.—From an announcement in the *London Gazette*, November 30th, we learn that this company will apply to the Board of Trade before the 21st inst., under the provisions of Electric Lighting Act, 1882, for a Provisional Order for authority to supply electricity for public and private purposes, within the area of the Westminster District Board of Works.

West Middlesex Electric Lighting Company.—By an advertisement in the *London Gazette* of November 30th, we learn that this company intends to make application to the Board of Trade before the 21st inst., for a Provisional Order to light the area under the management of the Fulham District Board of Works by electricity.

J. B. Rogers' Electric Light and Power Company.—Notice is given in the *London Gazette* of December 4th, that a petition for the winding-up of this company has been presented to the High Court of Justice by J. B. Rogers, electrical engineer, and that the hearing will take place on Saturday, the 15th inst., before Vice-Chancellor Sir James Bacon.

Electrical Companies' Shares.—At the sale on Thursday last by the Stock and Share Auction and Advance Company, £2 was given for Kelway's Electric Log Syndicate Shares. For London and Globe Telephone and Maintenance Company's shares no sale was effected, the reserve being too high.

Latimer Clark, Muirhead and Company, Limited.—It is with pleasure we learn that Mr. A. Le Neve Foster has been appointed manager of the works of this company. To give the necessary confidence to purchasers of its manufactures, perhaps no better choice could have been made, Mr. Foster's previous experience, and known capability, rendering him peculiarly well fitted for such a position.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Electro-Motor Syndicate, Limited.—At an extraordinary general meeting of the shareholders in this company, held at the offices, 3, Copthall Buildings, on the 14th ult., the following resolutions were duly passed:—(1) "That it has been proved to the satisfaction of this meeting that this company cannot, by reason of its liabilities continue its business, and that it is advisable to wind up the same, and accordingly, that the company be wound up voluntarily. (2) That Alexander Browne, Esq., be appointed liquidator for that purpose." The registered offices of the company are now at 5, Southampton Buildings, Holborn.

National Company for the Distribution of Electricity by Secondary Generators.—At an extraordinary general meeting of the shareholders in this company, held at 18, Warwick Street, Regent Street, on the 10th October, it was resolved to divide the nominal capital of £500,000 as follows, viz.:—3,000 £10 per cent. cumulative preference shares, of £10 each, 47,000 ordinary shares, of £10 each. At a meeting held at the same place on the 25th October, it was resolved that the directors receive by way of remuneration in each year (but not out of capital) the sum of £3,000 and such further sum as may be equal to 2½ per cent. of the surplus nett profits remaining after payment of the preference dividend, and also of 10 per cent. upon the ordinary share capital.

Protector Lamp and Lighting Company, Limited.—The annual return of this company, made up to the 24th July, was filed on 4th of August. The nominal capital is £30,000, in £10 shares; 2,972 have been issued, and upon 1,972 of these, £10 per share has been called and £6 per share upon the remaining 1,000 shares, the calls paid amounting to £25,720, being £2,000 in excess of the paid-up capital of last year. Registered office, Surdsley Mills, Worsley, near Manchester.

Hygienic and Electric Association, Limited.—The registered offices of this company are removed to 93, Regent Street.

Electric Brush and Appliances Company. Limited. The registered offices of this company are now at 69, New Bond Street, W.

NEW COMPANIES REGISTERED.

Simplex Electric Light and Plant Company, Limited.—Capital £40,000, in £5 shares. Objects: To purchase from the Protector Lamp and Lighting Company of Worsley, near Manchester, the following Letters Patent, viz.:—No. 4,676, 1882, granted for an invention of improvements in incandescent electric lamps and in the preparation of carbon filaments therefor; also a patent for an arc electric lamp and Nos. 3,470 of 1879 and 3,875 of 1880,† both for improvements in obtaining light by electricity and in the means and apparatus employed therefor. The total purchase consideration is £16,000, £6,000 thereof being payable in fully paid shares. Signatories (with one share each); John Clegg, Oldham; G. Roadbridge, Liverpool; *G. Furnerall and *T. L. Ormerod of Haslingden; M. Wells and W. Ambercrombie, of Manchester, W. E. Teale, of Worsley (managing director Protector Lamp and Lighting Company). The first directors are Messrs. G. Furnerall and T. L. Ormerod. Messrs. J. Clegg and W. E. Teale will join the board after the first allotment. Directing qualification 50 shares. Registered 28th ult. by Phelps, Sedgwick & Biddle, 18, Gresham Street.

* Those signatories whose names are preceded by an asterisk are also directors.

† These dates, although in accordance with the register, we think are incorrect. Probably they should be 1878 and 1879 respectively.

CITY NOTES, REPORTS, MEETINGS, &c.

The Faure Electric Accumulator Company, Limited.

An adjourned meeting of this company was held at the Cannon Street Hotel on Thursday, M. E. H. Cadiot, one of the directors, presiding.

The Secretary, Mr. Herbert Canning, having read the notice convening the meeting,

The Chairman said: Gentlemen, this is the third time that I appear before you at an adjourned meeting, and I am sorry to say that I have again to use the same words as on the last occasion. (Oh!) I knew beforehand that it would be a source of disappointment to you, but we can assure you most positively that we are doing our very best. Things are against us, and have been against us, and now I can only repeat what I have already said, we have every hope of succeeding, although we have not yet succeeded. We are perfectly blameless in the matter, and are doing our very best. When I last came before you there was produced the notice of the sale of shares of the French Metropolitan Electric Company, upon which I held out hopes to you which I still hold out; that is to say, on the success of that issue, or of that sale of those shares. There has been a lot of difficulties put in our way; I cannot say otherwise than that we really and firmly believe, and we have a certain amount of proof, that it is by the enemies of our scheme. At all events, the result of those sales of shares of the French Metropolitan Company by the group of financiers with whom we have been treating has been so far that only 6,000 have been disposed of. We have reasons to believe—very strong reasons—that at least three times as much—in fact the figures which are put before us are 25,000—have been sold; but they have been sold by parties with whom we have no contract, by parties who have thought of doing a special thing for their own benefit, and, I suppose, for the benefit of those to whom they sold the shares. However, of this fact we have only assumption, based on very good ground and the nearest thing to proof, that it is so; and steps have been and are being taken at present to ascertain the exact amount which would call those shares in. Of course the whole thing is a *fiasco*, and you can easily understand that the aim of those parties has been to depreciate the shares, and they have been offered at a discount. I do not know that I need say very much to you of what our position in the matter will be if the steps which are now being taken are successful; I need scarcely say we can, in fact, run the shares for what we like. But that takes time. This is the third time I appear before you, representing a period of nearly three months, it being on the 15th October that the first adjournment took place. At that time I told you "I expect it will be done to-morrow—next week—any time. Last night we were busily engaged in consulting upon the matter;" and so now, yesterday morning my two colleagues, whom I have brought with me in order that you may ask them any question you like, and I were engaged on the matter. M. Philippart has been deprived of the pleasure of coming; up to last night he was to have come, but we are continually on the breach of battle, and if any one be left on the field of battle in Paris it must be M. Philippart. We are unable to do what M. Philippart might possibly do himself. As he says, and as you must acknowledge, he is the largest proprietor; you must treat with him and carry out these things. Now, gentlemen, I can simply ask you again to wait, and I shall be very glad to answer any question you may ask, to the best of my knowledge and ability, and before closing the meeting will suggest what is best to be done. I must ask you really to adjourn for a longer period than before—to the 20th February. (Oh!) Well, it is entirely in your hands; I am not dictating to you. But I am behind the scenes and you are not. Do whatever you like; we are willing to do our best. I am here to tell you the truth, and in the best interest of everybody. Between this and the further adjournment I will undertake to say that one or two circulars shall be sent out privately to let you know what is going on.

Mr. Harcourt Turner: This is the third time you have come here with a similar story. You say you are behind the scenes, and that you have good reasons for anticipating success. We think the time is now come when you should tell us what those reasons are.

A Shareholder remarked that a committee was appointed in July to investigate the affairs of the company, and the time had now arrived when some active measures should be taken, and that committee put into operation.

Mr. Staples desired to know the result of the issue of the prospectus, or the arrangement by which the shares were to be taken. The chairman had said something about someone selling a large number of shares, whereas only 6,000 shares had been allotted. How could that be? He would like it explained; and also whether that venture had been successful or not; and, if not, what was the real position of the company so far as he (the chairman) knew it. He could understand that there were times when it was not advisable for directors to say all they knew; but when they met the first time, they were patted on the head, and told if they would be good boys and went away they should be told all next time; but the second time they were still patted on the head and told to go away. Now they had met a third time. They were not boys, and did not want their time wasted. It must have been very well known that this meeting for business was absurd altogether. A circular might just as well have been issued some two or three days beforehand, in order to explain the position, and why no meeting was necessary. If they had then chosen to come, and then chosen not to allow the adjournment, well and good; but the board had not given them the opportunity of doing so, and he protested against it.

Another Shareholder said he also must protest against it in the strongest possible manner. He had come for the third time from Brighton. At the last occasion the chairman said there had been no time to send out a notice, and undertook himself to see that it should not occur again; it had occurred again, and he thought it was most unpardonable on the part of the board to call them together again without any business to transact.

The Chairman: We did think of sending you a circular, but what would have been the result? You would have said that we were shuffling, that we were afraid to face you. We have done the very best, in our judgment, under the circumstances. What can I tell you more? 6,000 shares have been subscribed and applied for; and we have assumptions, based on such information that we are almost certain, that the total subscription has been 25,000. As director of this company I cannot tell you more, but must leave you to draw your own conclusions. I should be very glad to tell each one of you privately. My interests are also bound up in this company. For the last seven or eight months I have been continually backwards and forwards between Paris and London, and my business has, of course, suffered in consequence. I should not be likely to do this did I not believe that I should make money by means of the company. I have told you the truth, and desire to keep nothing back. A gentleman has suggested that the committee of investigation should be empowered to act. We had no hand in the appointment of that committee; but I tell you candidly that if you like to nominate one or two gentlemen, even those who have most scrutinised and criticised our policy, who would go most thoroughly into the affairs of the company, we are perfectly willing that they should do so, for we have acted strictly above-board.

A Shareholder asked if it was a fact that the party referred to as engaged in the sale of shares refused to hand over to M. Philippart the proceeds of those shares?

The Chairman said it was a fact; a question of legality was raised, as to whether it was an issue on the part of the Faure Company or not, the issue being really made by the French Electrical Company. But that was withdrawn, counsel having held that there was no illegality whatever.

Mr. Staples: Then, whatever cause there was for not paying back the money, it has been removed. Why has it not been paid back?

The Chairman: We believe it will be.

A Shareholder inquired respecting a large sum of money mentioned in one of the circulars issued by the Board, whether it was necessary, and whether it had been paid?

The Chairman: No; that was to float the company, and they (the syndicate) were to have a certain profit for selling the shares.

Another Shareholder asked if there was a prospect of any more shares being sold?

The Chairman: Absolutely so.

Another Shareholder would like to know where this money was to come from; from the Faure Company, from the proceeds of the sale of shares, or where?

The Brighton Shareholder said, as far as he understood, the syndicate would pay, whether in case of success or failure.

The Chairman: That certainly is so.

A Shareholder asked whether the company was in a position to pay the £30,000 which was due to the English Storage Company on the 31st December.

The Chairman: If we don't succeed I don't see how it is to be done; but I may say we are in perfect accordance with the English Storage Company. The manager of that Company has been almost constantly with us in Paris, and has been of great service to us.

The Shareholder: But the chairman of the English Company says if the money is not paid by that time the French Company will fall into the English Company. Are you pretty sure that you will be able to pay it?

The Chairman: The only thing I can answer is that we certainly are unable to pay the £30,000, but we hope to get an extension of time pending the negotiations going on, of which the English Company are fully aware.

The Shareholder asked was it fitting, was it right, that the chairman should only offer an opinion, when the time was so near and the penalty so severe?

Mr. Campbell stated that the property of the Faure Company consisted of a number of shares in the French Metropolitan Company, and it was the latter company which had to pay the £30,000; if it failed to do so it fell through, and the property of the Faure Company would be lost.

The Chairman fully expected some arrangement would be carried out, and pressed for the adjournment to the 20th February.

This was ultimately put to the meeting, and carried, only one shareholder holding up his hand against it.

The meeting then terminated.

The Telephone Company of Ireland.—Subscriptions are invited for 20,000 five per cent. preference shares of £1 each in this company, which was formed last year and is now in operation. The issue is made in order to provide capital for the extension of the business.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotatns, Dec. 5.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	8	2¼ - 2¾	2 7/16.
		Do. Do.	10	4¼ - 4¾	
30,000	5	Australasian E. L., Power & Storage Co.	3	⅛ - ⅜	
24,900	10	British Insulite Co., Ld., "A" Shares..	5	1 - 2	
30,000	5	Brush Elec. Lt. & Power Co. (Scotland)	2½	½ - ¾	
25,000	5	Gt. Western Electric Light & Power Co.	2½	¼ - ½	
24,980	5	Hammond Elec. Lt. & Power Sply. Co.	3¾	2⅜ - 2⅝	2½-⅝-⅜.
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2	..	
250,000	1	Maxim-Weston Elec. Lt. & Power Co. .	1	⅛ - ¼	
100,000	5	Metrop. Brush Electric Lt. & Power Co.	3	..	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	2½	..	
20,000	5	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.	2½	1 - 1½	
		TELEGRAPHS.			
1,892,480*l.*	Stk.	Anglo-American, Limited	100	42 - 43	
2,553,760*l.*	Stk.	Do. Pref. } Def. receiving no div. until	100	72 - 73	72-½-¾-3.
2,553,760*l.*	Stk.	Do. Def. } 6 p. c. paid to Pref.	100	13 - 14	13-⅞-14.
130,000	10	Brazilian Submarine, Limited	10	10¼ - 10¾	10 9/16-⅝-½-7/16- ⅜-¼.
16,000	10	Cuba, Limited	10	10¼ - 10¾	
6,000	10	Do. 10 per cent. Preference ..	10	17 - 18	
13,000	10	Direct Spanish, Limited	9	4½ - 5	
6,000	10	Do. 10 per cent. Preference ..	10	14½ - 15½	
65,000	20	Direct United States Cable, Ld., 1877 ..	20	10¾ - 11	11.
100,000*l.*	100	Do. 6 per cent. Deb., repayable 1884	100	100 -103	101.
380,000	10	Eastern, Limited	10	10½ - 10¾	10⅝-9/16-½.
70,000	10	Do. 6 per cent. Preference......	10	13 - 13½	13½.
232,000*l.*	100	Do. 6 do. Debs., repayable Oct. 1883	100	..	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101-104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	104-108	
250,000	10	Eastern Exten., Australasia & China, L.	10	11⅛ - 11⅜	11¼-5/16-¼.
320,000*l.*	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	108 - 111	
500,000*l.*	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	102 - 106	
140,000*l.*	100	Do. do. reg., repayable 1900..	100	103 - 107	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	101 - 104	
550,000*l.*	100	Eastern & South African, Ld., 5 p. c. Mort. Deb. Rg. redeemable 1 Jan. 1900	100	102 - 105	
	100	Do. do. do. To Bearer..	100	102 - 105	
22,050	10	German Union Telegraph & Trust, Ld.	10	10 - 10½	
250,000	10	Globe Telegraph & Trust, Ld.	10	6⅞ - 7⅛	7-1/16.
250,000	10	Do. 6 per cent. Preference	10	13 - 13¼	12 15/16-13 1/16.
150,000	10	Great Northern	10	13 - 13½	
100,000*l.*	100	Do. 5 per cent. Debentures ..	100	102 -105	
300,000*l.*	100	Do. 5 per cent. Debentures ..	100	102 -105	102.
81,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	29 - 30	29½.
100,000	100	Do. 6 per cent. Debs., 1886	100	102 -105	
18,000	25	Indo-European, Limited	25	31½ - 32½	
40,000	10	London Platino-Brazilian, Limited	10	3 - 3½	
12,000	10	Mediterranean Extension, Limited	10	1½ - 2	1½.
3,200	10	Do. 8 per cent. Preference	10	2 - 4	
10,000	8	Reuter's, Limited	8	8½ - 9	
338,225*l.*	Stk.	Submarine	100	200 -210	
75,000	1	Do. Scrip	1	1⅞ - 2⅛	
4,200	Cert.	Submarine Cables Trust	100	102 -105	
37,350	12	Telegraph Construction and Mainten.	12	35½ - 36½	
150,000	100	Do. 6 per cent. Bonds, 1884 ..	100	101 -103	
186,750	5	Do. 2nd Bonus Trust Cert. ..	2½	1½ - 1¾	
30,000	10	West Coast of America, Limited	10	5 - 5½	
150,000*l.*	100	Do. 8 per cent. Debs.	100	107 -109	108¼.
45,791	15	Western and Brazilian, Limited	15	5¼ - 5½	5⅜-7/16-½.
24,119	7½	Do. Preferred	7½	4 - 4½	
24,119	7½	Do. Deferred	7½	½ - 1	
200,000*l.*	100	Do. 6 p. c.. Debs. "A" 1910 ..	100	103 -107	
250,000*l.*	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	96 - 99	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Bg.) Bds.	$1,000	119 -121	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	102 -105	
88,321	10	West India and Panama, Limited	10	⅞ - 1⅛	
34,563	10	Do. 6 per cent. 1st Preference	10	6¾ - 7¼	6⅞-7⅛.
4,669	10	Do. 6 do. 2nd do. ..	10	4¾ - 5¼	
		TELEPHONES.			
224,850	1	Con. Tele. & Mainten., L., Nos. to 154,165	1	⅛ - ⅜	
225,000	1	Oriental Tele. Co., Nos. 80,001 to 300,000	½	⅛ - ⅜	
100,000	5	United Telephone Co.	5	8 - 8½	8¼.
20,000	5	Do. New, issued 2 p.m.	2	..	

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines during the month of November was 2,866, estimated to produce £2,550, against 2,005 messages, producing £1,842 in the corresponding month of last year. The receipts for August, estimated at £2,275, realised £2,315.

The West India and Panama Telegraph Company, Limited. The estimated traffic receipts for the half month ended the 30th November are £2,315, as compared with £1,128 in the corresponding period of 1882. The August receipts, estimated at £3,992, realised £4,060.

The Eastern Telegraph Company, Limited. The estimated receipts for November amounted to £49,390, and to £54,098 in the corresponding period of last year.

The Eastern Extension Australasia and China Telegraph Company, Limited. The receipts for November amounted to £34,413 and to £32,591 for the corresponding period.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for November are £1,771, against £1,998 in the corresponding period.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph Engineers and of Electricians.

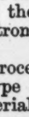
THE ordinary general meeting (which had been adjourned from the 22nd inst. in consequence of the death of Sir William Siemens, past-president) of this society was held on Thursday, November 29th, MR. WILLOUGHBY SMITH, president, in the chair. The minutes of the last ordinary general meeting having been read and confirmed, and the list of new, and proposed new, members read, a paper by Messrs. S. TROTT and F. A. HAMILTON, Associates, on "Submarine Telegraph Cables, their Decay and Renewal," was read by the secretary.

"The principal accidents to which submarine cables are liable are as follows:—Abrasion by ice and on rocky and stony bottom; ruptures caused by vessels' anchors; injuries inflicted by marine insects; *and the wringing asunder of the core by the iron wires.* Accidents arising from the first cause have not been numerous; indeed, taking into consideration the heavy masses of ice that beset the coasts and banks of Newfoundland and Cape Breton Island, and extend far west along the shores of Nova Scotia, it is marvellous that so few cases of crushing have occurred. With regard to breaks on rocky and stony bottoms, in deep water, it may be stated that cables are rarely chafed through, and it is believed that injuries attributed to this agency should in some instances be put down to quite another cause. The number of breaks which have occurred to some cables, in consequence of fishing vessels hooking them with their anchors, is greatly in excess of those brought about by any other means. With reference to faults caused by marine insects, it can be said that, although the Atlantic cables have not enjoyed a complete immunity, they have been remarkably free from any very serious attacks of these borers; these assaults, however, can be repelled by well-known means. How is it that cables suddenly sever during the process of laying or whilst being picked up, without any abnormal strain being indicated or applied? And why do they, in an equally mysterious manner, break in deep water, after having been successfully submerged? Iron-armoured cables have a strong tendency to twist or curl, as the spiral *lay* of the wires imparts a constant helical force in a direction contrary to the *lay*. Consequently, any slack given is apt to result in a kink or a succession of kinks, which is followed by a wringing asunder of the fabric when the strain is renewed. This accounts for most of the misfortunes which have happened in submerging some cables, for whenever it became necessary to stop or slacken speed in shifting from one tank to another, or for some other purpose, the risk of this accident has always been incurred. An iron-armoured cable cannot be recovered from deep water excepting in short lengths, because the operation of heaving in causes the armour to unlay or untwist, and this results in an accumulation of turns at and near the ocean bed, and a wringing or wrenching asunder of the fabric is sure to occur. Cables sometimes break in deep water, because when the iron wires become weakened by corrosion the curling or untwisting tendency is unopposed, and the stronger portions on either side of the weakened spot untwist, thus exerting a force contrary in direction on each side, but concentrated in action at the damaged portion. This is the whole secret—this is the *mysterious agency*, and thus it is that the most serious cause of injury to submarine cables must be attributed to the iron wires. Iron wires for deep-sea cables are not only undesirable but deleterious. That this so-called protective material has caused the loss of the 1865 and 1866 cables, their is conclusive evidence to show; and it may reasonably be assumed that the same destructive agency described is still at work, so that it becomes an imperative necessity to endeavour to provide a remedy, or at least to try to mitigate in some degree the evils arising from the cause named. The following opinions may be taken in evidence in support of the statements respecting the '65 and '66 Atlantic cables:—At the half-yearly meeting of the Anglo-American Telegraph Company, held February 7th, 1879, Lord Monck said: 'The failure of the 1866 cable was caused by oxidation of the iron wires and decay of the hemp.' (Hemp is practically indestructible, excepting when in contact with iron.) Mr. W. H. Preece, in a Cantor lecture, delivered April 28th, 1879, said: 'Submarine cables are really practically of only one type. . . . The form of the Atlantic cable of '65 and '66, which is similar to that of many other cables, was deficient, inasmuch as, while it possessed sufficient strength to enable it to be submerged, it had not sufficient durability to retain that strength to enable it to be brought to the surface again in a sufficient length to enable them to effect repairs. . . . Sometimes the cables rest on corrosive stones, copper ores, and ironstone, when corrosion sets in and causes the cables to speedily fail.' The following communication in regard to the abandonment of the effort to recover and repair the 1866 Atlantic cable appeared in the London morning papers of July 28th, 1878:—'The steamships *Seine* and *Calabria*, which were sent out by this company at the end of May, for the recovery and repair of the 1866 cable, returned to London this morning. The cable has been hooked several times, and partially raised to the surface; but the outside iron wires were so weak from the effects of oxidation, that its repair was considered impracticable by the engineers in charge of the expedition.

"'(Signed) HENRY WEAVER,
"'General Manager.
"'Anglo-American Telegraph Company, Limited,
"'26, Old Broad Street, London, E.C.'"

Mr. John Pender, M.P., stated, December 4, 1878, 'that it had been proved that the sea, instead of destroying the gutta percha, had the opposite effect: *it was only the iron wires that were affected*.' Sir William Thomson has also stated 'that the presence of carbonic acid in water is the great cause of iron being corroded.' Gutta percha is practically indestructible, but iron wire has caused the loss of many miles of submarine cables, and excepting when in contact with iron, vegetable fibre is indestructible. The core serving, which is composed of common jute yarn, has time after time done duty as the strength-giving material, although only intended as a padding for the iron armour. This core serving is invariably recovered in a wonderful state of preservation, but the yarns which envelope the iron wires suffer deterioration whenever the latter becomes oxidized. The testimony with regard to the enduring qualities of vegetable fibrous material is so overwhelming, that it may be considered that a cable constructed without iron wires, and with the strength-giving material composed of hemp, will not possess within itself the elements of decay. In the case of close-armoured cables covered with an outside serving carrying bituminous compound, oxidation is certainly retarded, but on some bottoms this is only the case to a very slight extent, so that it must be admitted that, wherever corrosion sets in and destroys the iron wires, they have proved themselves a source of weakness instead of strength; for where repairs are effected to cables in which the iron wires are useless, and the yarn portion is the means by which the repair is accomplished, it is plain that the iron is only an encumbrance. If the iron armour has to be protected by means of vegetable fibre and bituminous compound, why cannot a less perishable material be more effectually protected with the same coatings? Whenever close-armoured cables suffer corrosion, the wringing asunder of the core is more likely to occur than it is in the case of a strand cable; for if the corrosive action is confined, as is often the case, to one particular spot, on either side of which their is a considerable length unattacked, the untwisting of the armour at the weak place exerts a more powerful force than that which would follow under similar conditions on a strand cable. If the deterioration were general for any considerable length, there would be less danger of rupture, for then the turns resulting from the untwisting would be distributed. The authors are aware that various types of light cables have been devised, and that the question has been discussed from time to time by the members of this society and by others; but the subject has been allowed to drop, partly on account of the fact that some unsatisfactory feature has rendered the adoption of the suggested type undesirable, and partly because of the very strong feeling which exists in favour of heavy armour."

The authors next proceeded to state what, in their opinion, was the most suitable type of cable for the deep Atlantic. "The strength-giving material, by means of which the core can be submerged and recovered, should consist of fibrous yarns or strands made up in such a manner that any twisting or wringing of the fabric is prevented; and, in order to accomplish this, the authors lay over the insulated conductor a series of spiral or helical servings of non-metallic fibres, yarns, or cords, laid alternately left and right, *the fibres, yarns, or cords of each serving being twisted in a direction the reverse of that in which they are wound about the insulated conductor*. This point or feature, although at first sight a trifling consideration, is of the utmost importance, as it constitutes the gist and substance of the principle by means of which any twisting or knuckling of the cable is prevented; for it will be seen that, if the yarns or cords of each serving be similar,—that is to say, if they be twisted in the same direction in forming them,—the cable will kink, notwithstanding the servings be wound alternately in right and left hand spirals about the core. Figs. 1, 2, 3 and 4 represent the yarns and cords with which the insulated conductor may be served, and figs. 5 and 6 represent completed cables made up of such yarns and cords. In the case of a cable constructed as shown in fig. 5, it is obvious that the natural tendency of the first layer or serving to untwist will hav the effect of twisting up, and consequently hardening, the yarns composing such layer, as the yarns are laid on in the opposite direction to that in which they are twisted. So, likewise, the following layer or serving, being composed of yarns twisted oppositely to those of the first layer, and wound around in a reverse direction, will not only oppose any untwisting tendency of the preceding layer, but be hardened and consolidated in like manner, and the whole fabric will be compensating in character—that is to say, the outer layer will prevent the inner layer from causing any kinking or knuckling, and the like effect will be produced on the part of the inner layer. The same result will, it is obvious, be produced by means of the cords shown in figs. 3 and 4, when laid on in the manner illustrated in fig. 6; and it is also equally plain that the laying on of the spirals may begin either to the right or to the left, the essential point in this regard being that succeeding spirals shall reverse their direction. The servings may be coated, saturated, or filled with tar, bitumen, asphalt, or other preservative material, and may be wrapped with yarn or tape. A cable such as described would not only be more durable than an iron-armoured one, but could be recovered with ease and certainty from any depth. Strength, lightness, and durability are among the chief requirements in a submarine cable, and these qualifications are to be found in the type which is submitted to the consideration of the society."

1


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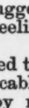

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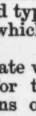

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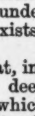

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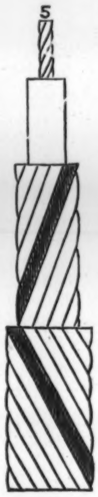

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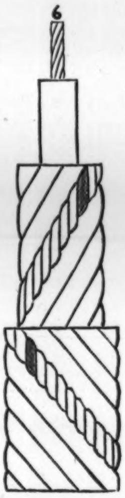
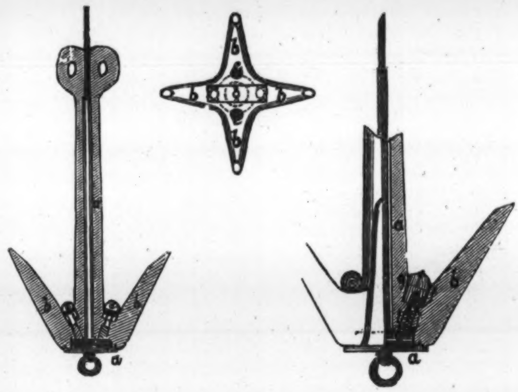


A paper was next read by Capt. TROTT, on "Trott and Kingsford's Automatic Grapnel, for Submarine Cables and Torpedo Lines." All those who are acquainted with the cable-lifting branch of submarine telegraphy are well aware how important a matter it is in grappling to be certain of the instant the cable is hooked. This importance increases, of course, with the age and consequent weakness of the material, as the injury caused by dragging a cable along the bottom is obviously very great. It is easy also to understand the fact that in nearly all cases the most delicate dynamometers must fail to indicate immediately the presence of the cable on the grapnel, more especially in those cases where a considerable amount of slack grapnel rope is paid out. In many cases, therefore, the grapnel will travel through a cable without the slightest indication (or at least reliable indication) occurring on the dynamometer, and perhaps several miles beyond the line of cable will be dragged over, either fruitlessly, or to the peril of neighbouring cables; whereas, should the engineer be advised of the cable's presence on the grapnel, the break will probably be avoided and the cable lifted, at any rate the position of the cable will be an assured thing. In addition to the foregoing remarks *re* the insufficiency of the dynamometer as an instrument for indicating the presence of a cable on the grapnel, troubles and perplexities occur incessantly in dragging over a rocky bottom. The grapnel hooks a rock, a large increase of strain is indicated on the dynamometer, and it becomes doubtful whether the cable as well is hooked or not. Again, it frequently happens in grappling over a rocky bottom that one or more prongs are broken off, the grapnel thus becoming useless, great waste of time being thus occasioned. Fully realising all the difficulties herein enumerated, it occurred to the authors that a grapnel might be constructed in such a manner as to automatically signal by electrical means the hooking of the cable, while it would ignore all strain that external causes might bring to bear on it, and thereby obviate the uncertainties attached to the use of the grapnels at present in vogue. To effect this, early in 1881 a grapnel was designed fitted in each prong with an insulated conducting surface and a plunger and pin so arranged that the cable, when hooked, should by the pressure that it would bring to bear on any of the plungers, cause the pin to come in contact with the conducting surface, itself in electrical communication with any suitable current detecter and battery on board the repairing ship, and thereby complete the circuit. This grapnel was successfully used on the Anglo-American Telegraph Company's repairing steamer *Minia* in the summer of 1881, and a patent, No. 13,665, was granted the inventor, Mr. Kingsford, in Canada for the same, on November 10th of that year. Subsequently certain alterations were made, and the improved form of apparatus was patented in England, France, the United States, and Canada. This improved form may be constructed either with a contact-plate in each prong or with one contact-plate common to all the prongs: the latter is somewhat simpler, and is therefore the plan that is usually adopted. The former description of grapnel has one advantage over the other in this respect, viz., that should a prong be ruptured so as to render it useless, the fact would immediately be known on board. A circuit formed in such a manner, by the breaking off of a branch lead, would have greater resistance than that formed by the contact resulting from pressure of cable on the plungers: this difference would be manifested on the indicator (of low resistance) placed in circuit with the alarm-bell, or, if any donbt remained, Wheatstone's bridge, or, simpler still, a telephone might be made use of. The water is allowed free access around and about each separate part, in order that its pressure shall be equal on all sides. This arrangement renders the grapnel as effectual in the deepest as in the shallowest water. By making the plungers in two pieces, with a rubber washer or its equivalent between them, mud or ooze is prevented from getting behind and interfering with their working. As the hole in the rubber surrounding the contact-plate, caused by the passage of the pin through it, closes up as soon as the pressure is removed, it leaves in the rubber a fault of exceedingly high resistance, so that the rubber does not require renewing. In the rubber in which is embedded the contact-plate, is placed a layer or more of tinfoil or other easily pierced conducting surface, through which the pin passes on its way to the contact-plate proper. The grapnel thus described has been in use on the *Minia* since April last. It has never been known to fail. No swivel has been used with the rope, in the heart of which is the insulated wire, as it would allow the grapnel to turn over on the bottom, and would be apt to twist and break the wire short off. As a matter of fact, the grapnel will turn, and does turn, with the rope; a swivel is therefore of no value. A small type of grapnel fitted in the manner described may be very advantageously used for searching purposes, to ascertain the position either of telegraph or torpedo lines: by towing at a quick rate much time may be saved. The position being ascertained, if it be not desired to lift the cable, the grapnel can be released and hove on board by a tripping line, which can always be attached when such work is contemplated. The great importance of being able to localise an enemy's torpedo lines without raising an alarm will be readily seen by engineers engaged in torpedo work.



a is the stem of the grapnel containing core.
b, flukes.
c, recess for insulated contact-plate connected to core.
d, covering plate screwed on bottom of grapnel.
e, button of plug.
f, rubber washer and button.
g, metal-plate.
h, stem of plug, on which in the under counter-sink "U" is a small metal disc which prevents the fittings from falling out.
i, needle.
j, spring.
k, counter-sink for head of plug.
l, counter-sink for spring.

In the discussion which followed the reading of the papers,—

Mr. WILLOUGHBY SMITH said that Messrs. Trott and Hamilton had practically asked that a fresh trial of hemp for protecting cables should be made. A trial of the material in question had lasted for several years, and the result had been that iron was ultimately adopted as being the only really satisfactory material. When the Atlantic cables were under consideration, seven samples of light cables were made but none proved to be satisfactory. A hemp cable had been laid across the Irish Channel but it failed, the Candia-Alexandria was practically a hemp cable, but this failed also. The Atlantic cable of 1865 was a compromise between iron and hemp. With reference to the "wringing asunder of the core," he would state that the core could be twisted fifty times without being broken. As to the breaking of cables when being laid, he would mention that the Telegraph Construction Company had laid 94,000 miles of cable and a break had never taken place during the laying. He knew of no case in which a cable had parted in deep water after being laid. In cases where faults had occurred they were traceable to the broken ends of the sheathing piercing the core. With reference to the failure of the *Scotia* and the *Calabria* to pick up the old Atlantic cable, it should be recollected that it had been down for 14 years. Vegetable fibre was stated to be indestructible, but in many cases, in the Mediterranean, for instance, it was found that hemp was very quickly destroyed. In 1858 he had made a specimen of a light cable, but this when immersed in water buckled up through shrinkage. No matter how carefully hemp is waterproofed it is impossible to keep out water entirely. He thought that without extensive experiments no company would be justified in laying a light cable.

Mr. FORD said that he was once in favour of light cables. In 1855 a bare core, 300 miles long, was laid between Varna and Balaclava, which worked for nine months, but afterwards broke 10 miles from the shore. 150 knots were laid between Varna and Constantinople; the sheathing in this case consisted of 12 small wires, but the cable only lasted a short time. The 1858 Atlantic cable weighed 16 cwt. in water; the Cagliari cable was also a light cable, but neither lasted long. The Red Sea cable was of a light type, but the failure in this case was due to too little slack being paid out. A light cable sheathed with brass riband was laid between Spain and Algiers by Messrs. Siemens, but this failed. Specimens of light cable were made when the Falmouth-Gibraltar cable was under consideration, but if this description had been laid he was confident it could not have been picked in case of failure. The strongest type was, he considered, iron or steel wires in hemp strands. He did not think that failures in deep water were the result of chafing, but probably from too little slack being paid out, and from the laying being too quick. Animals did not cause faults in deep water. Hemp, he thought, was certain to decay sooner or later. The durability of Atlantic cables was from $8\frac{1}{2}$ to $10\frac{1}{2}$ years, but the 1869 cable, which was still at work, had been down 14 years, and had been twice repaired. The Malta-Alexandria cable had been down 15 years and had never failed. The Suez-Aden cable had been down 14 years and was quite good. The best type of cable, he considered, was an iron-sheathed one with the iron covered with gutta-percha as a protecting covering. With reference to the picking up of cables, he had hardly ever known accidents from twisting and coiling like that referred to in the paper. Hemp forms a nest for boring animals. He had some time ago discussed the question, with Prof. Fleeming Jenkin, whether six bare cores across the Atlantic would not prove economical, it being taken into consideration that the cores could not be repaired; these six cores could be laid for £100,000. Hemp, he thought, would rot, no matter how well preserved.

Mr. EDWARD BRIGHT doubted whether, in the grapnel of Messrs. Trott & Kingsford, the insulation could be preserved. He noticed that no provision had been made for a length of chain, which is necessary to prevent chafing of the grapnel rope. The cost of the grapnel, he thought, would be considerable, compared with the ordinary form; it was also very likely to give false signals if fragments of rock or coral got in between the prongs. In order to resist abrasion, it was absolutely necessary that cables should be sheathed with iron. The "wringing asunder," he thought, never takes place, as there is no twist in the iron wires when they are laid or during manufacture; great care is always taken to avoid this. Hemp cables, he believed, would not stand "dragging." He might mention that the Persian Gulf cable had been down 20 years and was still in good working order.

Mr. CRAMPTON said that he had had to design the first Channel cable, laid in 1851; he then came to the conclusion that a light cable was ridiculous, at least for the Channel. He would have nothing to do with light cables for crossing the Atlantic, as he considered them entirely a mistake. It was no doubt possible that it could be done, but he thought it would be most imprudent to try the experiment. 7 or 8 tons was, he considered, the lowest breaking strain that should be allowed. With reference to the grapnel, he did not think cost was of any account; the invention would be most useful for light cable purposes, as it was difficult to tell whether such a cable was hooked.

Mr. PREECE said that it seemed to have been overlooked that the authors of the papers had had very considerable experience in cable repairing, and that they would not have ventured to explain the breakage of cables as being due to the cause they stated unless they had very good grounds for the same. Messrs. Ford and Bright in their arguments had quite lost sight of the point at issue, namely, that the authors had brought forward a *new* type of hemp-sheathed cable. He thought that there was ample evidence brought forward to prove that there was a wringing force which broke cables.

Captain TROTT, in replying, said that the Irish cable referred to was not a cable in the true sense of the term; the covering was of white Manilla hemp, unpreserved. He did not wonder at an ordinary rope-laid sheathing shrinking. The fact that fractures of the kind he referred to were found on perfectly level bottoms proved that there was a wringing action which caused the breakages. He had seen cables break in the manner he indicated when passing over the stern of the ship. He knew of very numerous cases in which cables held together solely from the strength of the hemp serving. With regard to the amount of slack paid out, he pointed out that on a level bottom 8 per cent. represented a very considerable quantity. The durability of the serving would depend upon the kind of hemp used; Russian hemp would remain perfectly good for an almost unlimited period. In reply to Mr. Preece, Captain Trott said that breakages of cables when paying out almost invariably occurred at the ocean bed, where there could be no strain. With further reference to the lasting properties of hemp, he showed a specimen which had been under water for *seventy-nine* years, and was still in perfect condition. At the Fisheries Exhibition, specimens of rope from the wreck of the *Royal George* were on view which were quite sound, though they had been submerged for fifty years.

Mr. Hamilton said it was clearly stated in the paper that only deep sea, and not shore or shallow water cables, were proposed to be sheathed with hemp. All the experience which had been had of light cables was *old* experience, and of but little value. A piece of cable, constructed on the authors' principle, had been manufactured and laid across Halifax Harbour, which was infested with insects; it was now in a perfectly good condition. The breaking strain of their cable, of which he exhibited a specimen, was from 4 to 5 tons.

The usual vote of thanks having been proposed and carried, the meeting then adjourned.

Physical Society, November 24th, 1883.

Prof. R. B. CLIFTON in the Chair.

Prof. Reinold read a paper by Mr. J. W. Clark, "On the purification of Mercury by distillation in vacuo." The advantages of Mr. Clark's apparatus, are the small quantity of mercury in use at a time, and the fact that no auxiliary Sprengel pump is required. This is avoided by having a moveable reservoir of mercury, on raising which the distiller is filled with mercury. The apparatus was described in detail, and illustrated by a figure. It is probable that zinc, cadmium, magnesium, &c., may be distilled, and thus purified by the same apparatus.

Mr. A. P. Chattock then read a paper "On a Method of Determining experimentally the Constant of an Electro-dynamometer." In existing methods it is necessary to measure the areas of the coils, which is a difficult matter to do, with a finished instrument; by the new method this is unnecessary. It depends on the accurate determination of the speed of the movable coil. Mr. Chattock exhibited an instrument whose constant had been determined by him in the laboratory of Prof. Foster, University College, with the assistance of Mr. Grant.

Prof. G. C. Foster then took the chair, and Prof. R. B. Clifton, president, read a paper "On the Measurement of the Curvature of Lenses." With very small lenses the Spherometer cannot be used, and the author's method is based on the Newton's rings formed between the lens and a plane surface, or a curved surface of known radius. From the wave length of the light employed in observing, and the diameter of a ring, the radius of curvature can be determined. He places the lens on a plane or curved surface under a miroscope, and lights it by the sodium flame (wave length ,5892 × 10^{-7}); he measures the approximate diameters of two rings a distance apart (in practice the tenth and twentieth rings are found convenient), takes the difference of their squares and divides it by the wave length and the number of rings in the gap between. To find the radius of the lens the formula is—

$$\rho^1 \, m \, \lambda = \left(x^2_{m+n} - x^2_n\right)$$

where x_{m+n} and x_n are the diameters of the n^{th} and $(m + n)^{th}$ rings; λ is the wave length of the light, and ρ^1 the radius of the curvature of the lens. The method, with proper care, gives accurate results. Prof. Clifton has also used it to determine the refractive index of liquids in small quantities. Mr. Richardson has found it for water = 1·3335 by this method, which is usually correct, to two places of decimals. It can also be used to determine if the lens is uniformly curved and spherical. Prof. Perry suggested that it might be also used to measure a surface without touching it, say the surface of a water drop; or a strip of glass when bent. In this way it might throw light on the laws of capillarity or of bending.

NEW PATENTS—1883.

5025. "Checking the visits of watchmen and caretakers to various parts of buildings or other places."* J. W. Fletcher. Dated October 23.

5482. "Electrodes used in the electro amalgamation of gold and silver and other ores." R. Barker. Dated November 22.

5503. "Telegraphic and telephonic apparatus." H. H. Lake. (Communicated by F. Van Rysselberghe.) Dated November 23.

5504. "Electrical cut-outs or apparatus for automatically breaking electrical circuits." F. G. Howard. Dated November 24.

5524. "Secondary batteries." G. F. Prescott. Dated November 26.

5535. "Telegraphic relays and repeaters." J. H. Johnson. (Communicated by J. A. Maloney and G. W. Cooper.) Dated November 27.

5539. "Improved means for supplying an electric current to the commutators of electro-motors, or collecting the current from the commutator of electric generators." M. Immisch. Dated November 27.

5540. "Secondary voltaic batteries." A. Khotinsky. Dated November 27.

5545. "Microphones." F. J. Semal. Dated November 27.

5548. "Incandescent electric lamps." J. C. Mewburn. (Communicated by J. Kahn and J. Bräuer.) Dated November 27.

5562. "Machinery, or apparatus for generating electric currents or energy." A. B. Cunningham. Dated November 28.

5584. "Electric igniting apparatus." H. J. Haddan. (Communicated by E. Witte.) Dated November 30.

5611. "Insulators." G. W. Hannam. (Communicated by S. Oakman.) Dated December 3.

5615. "Portable electric light apparatus." H. J. Haddan. (Communicated by Jos. Beduivé.) Dated December 3.

5619. "Telegraph and telephone wires." A. J. Boult. (Communicated by G. Gray.) Dated December 3.

5626. "Electro-telegraphic system particularly applicable for long cables." S. Ross. Dated December 4.

5638. "Improvements in instruments called 'Ammeters,' 'Voltmeters,' 'Powermeters,' and 'Ohmmeters.'" F. V. Anderson. Dated December 4.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

1617. "Electric lamps and carbon conductors for the same." W. R. Lake. (Communicated from abroad by C. Dion of Paris.) Dated March 30. 10d. Relates to electric arc lamps and to carbon conductors for the same, and is designed to provide greater simplicity of parts and cheapness of manufacture than are to be found in the lamps heretofore in use, and also a perfectly automatic action, together with a perfect steadiness of the light.

1620. "Voltaic arc lamps." B. J. B. Mills. (Communicated from abroad by O. A. Moses of America.) Dated March 31. 10d. Relates to voltaic arc lamps, and its object is to furnish a lamp of exceedingly simple and economical construction, with provision for automatically controlling the feed of the carbon, by means of a solenoidal or magnetic governor of few parts, but efficient in operation, and especially adapted to be used in multiple arc systems, with other lamps of the same type, or with incandescent lights, but also capable of being used in series or multiple series.

1632. "Electric signalling apparatus, &c." W. H. Preece and W. E. Langdon. Dated March 31. 6d. The object of this invention is to provide improved and economical appliances for establishing a means of communication between the various parts of a railway train in motion or otherwise. To this end the inventors employ an improved form of coupling, so arranged that it requires but one action to join or couple together the ends of any two vehicles, and so arranged that it can only be coupled up in that manner requisite to ensure the necessary and proper connection between the wires forming the means of communication. The mechanical portion of this coupling is purposely arranged similar to the brake coupling employed in certain automatic railway brake apparatus, in order that the mode of coupling both the brake and electric communication may be similarly readily and efficiently dealt with by those whose duty it is to connect together the several parts of the train as it is made up. In order to afford passengers and others a means of communication with the guard and driver, a wire, rope, or, say, a rod, is passed throughout the length of the carriage or vehicle, one end of which may be rigidly fixed to one end of the vehicle, whilst the other end is fixed to the lever or handle of a commutator fixed at the end of the said vehicle (or each end may be fixed to a commutator). This wire rope may be carried through the several compartments of a railway carriage open, or it may be partially covered, or it may be entirely covered and open to view through a fixed piece of glass at one or more places within each compartment. The commutator itself is so arranged that in its normal condition the wires forming the electrical communication are separated, but upon the wire rope passing through the several compartments being pulled in any one of the said compartments the commutator is operated and the electric current caused to flow. Or in the absence of a fixed commutator the wire rope may be employed to separate the coupling by being pulled in a like manner from any one of the compartments. The improved form of coupling is shown in perspective by fig. 1, in end view by fig. 2, and in longitudinal section by fig. 3. A, A^1, are metal castings, each being similar and cast from the same pattern. At the upper portion of each is a projection, *b*, b^1, and adjoining this is a slot, *c*. At the bottom portion of this casting, or opposite to the projection and slot, is a hook or horn, *d*, d^1, respectively. The slot, *c*, is so arranged in each half coupling that the corresponding projection of the other

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* [This is, we are informed, an electrical method, although in the Patent Office Journals there is no indication that such is the case.—Eds. Elec. Rev.]

half of the coupling fits into it, and the hook, *d*, of the one engages with the hook, *d*¹, of the other, and when thus set together, as shown in fig. 1, the coupling is complete; *e*, fig. 2, is an india-rubber washer for making joint and excluding moisture. The electrical arrangement within this coupling is composed of two flat springs, *g*, *g*¹, fig. 3, fixed to a boss, *f*¹, of ebonite, which boss is fixed within the tubular portion of the casting. To the springs, *g*, *g*¹, are fixed ebonite blocks, *e*¹, *e*², faced on their opposite sides by pieces of metal, *h*, *h*¹, which are formed each with a recess or hollow and a lug. The ebonite blocks are in their transverse section of the form of triangles, sectors, or quadrants of a circle, so that when the two blocks from one half coupling are brought together with the two blocks from the other half coupling they form a square or circular body. Each quadrant is tapered towards the points, *e*, *e*¹, and under the influence of the springs, *g*, *g*¹, to which the electrical wires forming the communication are attached, they rest one upon the other at these extremities. Each half coupling is fitted alike, so that the one may engage with the other. Thus the part A (fig. 1) is provided with two electrical quadrant-shaped blocks similar to the part A¹. The ebonite blocks being partly faced with metal, as shown in fig. 2, when they are set together the metal face of the one quadrant forms contact with the metal face of the other, the lug on one fitting in the corresponding hollow of the other, and completes the connection of the two wires which are connected to the springs, *g*, *g*¹—thus forming the communication. When thus set together the points of contact in one half coupling which touched each other will, by the tapered shape of the quadrants or segments, be forced apart at those points of contact, and the lugs on the part, *h*, of the one coupling will form contact with the corresponding hollow on the part, *h*, of the other half coupling, and the projecting lug on the part, *h*¹, of the one half coupling also in contact with the corresponding hollow on the part, *h*¹, of the other half coupling. Now, in order to economise the cost of this means of communication, it is proposed to place within each carriage one electrical commutator only, and to operate this commutator by means of a cord, wire-cable, rod, chain, or other convenient means, from the same and other compartments of which the railway carriage is composed, which cord, &c., also passes throughout the interior of the carriage.

FIG. I.

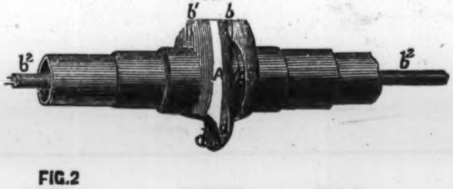


FIG. 2

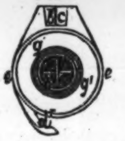
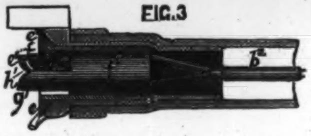


FIG. 3



1639. "Dynamo-electric machinery, and apparatus for use in connection therewith, &c." S. P. THOMPSON. Dated March 31. 8d. Relates to dynamo-electric machines to serve as generators of electric currents or as electric motors. Some of the said improvements are also applicable to other motors, such as gas, steam and water engines. In the improved machines the field-magnets, however excited, are fixed; the armature coils are also fixed, their cores being sometimes constructed with iron, sometimes without iron. Instead of rotating either of these the inventor rotates between them inductors, which may consist partly of iron or other magnetic metal, and partly of non-magnetic or of non-metallic matter. The improved methods of governing the speed of motors comprise the periodic cutting of the current either in the armature coils or in those of the field-magnet, the periodic introduction of a fixed resistance into the circuit either of the armature or of the field-magnet, the periodic alteration of the resistance of the armature or field-magnet, the periodic introduction into the armature coils or those of the field-magnet of a counter-electromotive force; a periodic short circuiting of part of the coils either of the armature or field-magnet, a periodic closing or opening of a shunt circuit wound in such a direction as to oppose the magnetism of either the armature or the field-magnets. They also comprise the production of a relative motion between the armature and the commutator, or between the commutator and the brushes, or between the brushes and the armature, or between the brushes and the field-magnets.

1640. "Apparatus for igniting petroleum, gas, or other lamps by electricity." G. W. VON NAWROCKI. (A communication from P. Richter of Potsdam.) Dated March 31. 2d. Relates to apparatus whereby by simply compressing an india-rubber ball filled with air, or by pulling a string or wire, or by other suitable means, a person is enabled to light one or more petroleum or other lamps fitted to the wall or ceiling of a room, or in other suitable positions, simultaneously, by means of an electric current. (*Provisional only.*)

1641. "Machinery and apparatus for conversion of electricity into mechanical power." C. A. MULHOLLAND. Dated April 2. 2d. Consists of a permanent magnet of any given size, fixed vertically or horizontally; before its poles, two or more armatures wound with fine insulated copper wire are made to rotate; the currents induced by the rotation of the armatures, before the poles of the magnet, are collected by a commutator and transmitted constantly in the same direction. (*Provisional only.*)

1644. "Working secondary batteries or electrical accumulators, &c." J. S. SELLON. Dated April 2. 6d. Has for its object the effecting the cutting out of or putting into the charging circuit secondary batteries, commonly called electrical accumulators, by means of the motion imparted to an acidometer or other instrument or appliance—such, for instance, as a float or ball or vacuum box, which can be made to rise or fall, or be actuated in accordance with the variation in strength, density, or specific gravity during charging or discharging of the electrolyte or fluid employed in such batteries.

1645. "Telegraphic and telephonic wire." L. ELMORE. (Communicated from abroad by W. B. Hollingshead of America.) Dated April 2. 4d. Relates to wire particularly adapted for telegraphic and telephonic communication. According to this invention the core of the wire is made preferably of steel, around which, in the form of a close spiral, is wound copper wire, electrical connection being assured between the surfaces of said copper wire by means of electro deposition of a copper coating.

CORRESPONDENCE.

The Utilisation of the Forces of Nature.

The storage of mechanical force by means of the wind and the raising of a heavy weight will be an accomplished fact before long. The employment of lead, iron, or granite as the weight to be lifted is not at all necessary; of course broken granite *could be* used, and each piece of granite *could* be ground and polished—the latter would be as unnecessary as the broken granite itself.

The weight might consist of a wrought iron tank of suitable shape, filled with water.

No one disputes the capacity or advantages of the secondary battery as a storer of energy. What is needed is a ready and cheap source of primary power to store.

If the intermittency of the wind is of no consequence, then use the wind engine direct; but if the power must be constant, then either of the means I pointed out in the ELECTRICAL REVIEW of August 11th will meet the want.

London, *Dec.* 1*st*, 1883.

A. J. Jarman.

Atomic and Equivalent Weights of Elements.

Your correspondent, Mr. Carswell, expresses his views as to the values to be taken as the "equivalent weights" of certain elements in somewhat strong language, although these views are altogether opposed to those held by received authorities, and should therefore have been expressed with a little becoming modesty.

Referring to Miller's "Elements of Chemistry" (3rd edition) vol. I. p. 19, I find that the "equivalents or combining proportions" of the two triad elements mentioned by Mr. Carswell, are given as follows :—

Au	...	196·66
N	...	14·

The equivalents of the other element quoted by your correspondent is further given as

Sn	...	59·

In the list of "atomic weights" prefixed to vol. II. of the above work, I find :—

Au	...	196·6
N	...	14
Sn	...	118

On p. 25, vol. I. of the same work, I find that Au and N are classed as triads, whilst Sn is placed amongst the tetrad elements.

Messrs. Abel & Bloxham in their "Hand-Book of

Chemistry," p. 106, give the following as the "equivalent weights" of the elements in question :—

Au ... 196·6
N ... 14
Sn ... 58·8

Lastly, referring to a more modern work, Mr. Sprague's "Electricity," I find a table from which I extract the following :—

Symbol.	Atomic Weight, New.	Equivalent, Old.	Valency.	Electric Equivalent.
Au ...	197·	197	3	65·7
N ...	14·	14	3	4·7
Sn (ous)	118	59	2	59·
„ stannic	„	„	4	118

Perhaps Mr. Carswell has got rather "mixed" in considering the *chemical equivalents* of the old chemists and the *electric equivalent* of some modern electricians.

D. Armytage Davis.

75, Clarendon Road, W.,
Dec. 4*th*, 1883.

The Lightning Conductor Controversy.

As far as I understand the argument of Colonel Parnell, it is that the lightning flash passes from earth to cloud; if this is so, Benjamin Franklin's experiment must have been all a farce. Franklin stood upon a stool with glass legs, flying his kite with a conductor attached to the cord and a key at the end of the conductor. Now, if Colonel Parnell is right, the *fluid* must have passed up the glass legs of the stool through Benjamin Franklin, over, or through the insulator held by Franklin and into the two Leyden jars placed to receive it.

When Colonel Parnell is able to prove by experiment his views as clearly as Franklin did his, those views may become accepted, but not until then.

A. J. Jarman.

London, *Dec.* 1*st*, 1883.

Submarine Cables.

Being much interested in the question of submarine cables—their decay and renewal—I, as an associate of the Society of Telegraph Engineers and Electricians, attended a meeting of this society on Thursday last, at which a paper on the above subject was read.

In this paper we were given the benefit of the joint authors' experience in recovering and repairing cables laid in deep and shallow waters; one of these gentlemen having been engaged on this work for the past nine years, and the other for a considerably longer period; now I think all of us should listen with deference to any account of results of *practical experience*, even those of us whose connection with ocean telegraphy extends back to 1851; I was, therefore, much disappointed when, after having listened attentively to the paper itself, the reading of which lasted hardly 20 minutes, we had to undergo the penalty of having an autobiography of one gentleman, lasting 35 minutes, a semi ditto from a second, taking up over 20 minutes of valuable time, and a recapitulation of the first two gentlemen's observations from the lips of a third, interspersed with his personal experiences.

Now, the president took the chair at 8.0 p.m. punctually, and the reading of the minutes of previous meetings, &c., took up 15 minutes, so that after the paper and the autobiographies we had 10 minutes (in reality 7) for legitimate discussion; the gentlemen who monopolised our valuable time having none of them such experience in the recovery of cables as can be gained by nine years constant work at it, they may be the first men of the day at *laying* cables, but they are very very rarely present when their handiwork comes to light after blemishes and imperfections have been lying unseen beneath the waters. And yet they pooh pooh theories put forward by men who do see these imperfections, and their results, and that day after day, and talk at such length (entirely ignoring the real question), that we are deprived of the benefit of general discussion on the subject with the possibility of practical answers from practical men, to any questions which we may put forward from a theoretical point of view.

I write at length, feeling we ought to have *general* discussion at these meetings, and if this letter has any effect in procuring that, I shall feel I have done not a little good.

General Discussion.

November 30*th*, 1883.

Atlantic Cables.

Will your correspondent A. O., who seems so well informed upon matters connected with Atlantic Cables, tell us whether the "Exclusive right for 20 years of landing at the Azores" mentioned by the *Figaro*, includes the obligation to join the various islands of the archipelago together and with Portugal, and if so, why he does not provide in his estimates for the two-span route for some 2,000 miles of cable extra for the unproductive branches, and for working and maintaining them?

Nemo.

3*rd Dec.*, 1883.

The "Glasgow" or "English Mechanic" Receiver.

Major Barney's letters are always readable and generally interesting, as they possess the charm of unconscious audacity, with a liberal dash of *bon homie.*

For his reply to my inquiry I am both gratified and grateful; my only regret being that I cannot afford the luxury of sending him the instruments with a "liberal fee" for his *authoritative* opinion.

D.

3*rd Dec.*, 1883.

Gravet's Slide Rule.

I have been asked over and over again by correspondents, many of them readers of your paper, to give them a detailed description of Gravet's Slide Rule, and therefore I ask for a small space in your valuable columns for this purpose.

M. Gravet's Rule is divided into four scales on the face, much the same as any ordinary slide rule, with the addition that it has a sliding piece of brass, or "index" to mark off any given numbers. This enables us to commence a formula and perform the whole equation without having any recourse to a pencil or even to mental exertion. The equation can by this means be easily and rapidly solved no matter of what magnitude, nor does it make any difference if it embraces square or cube roots.

The back of the slide contains a scale of sines, a scale of tangents, and a line of logarithms.

There is a recess at each end of the rule which are also used as indices, so that in working out Trigonometrical questions you have but to mark the desired angle of which you want, say, the sine or the tangent respectively, and the answer is at once read off on the face of the rule.

It is a very difficult thing indeed to find a reliable Slide Rule, but I am sure that if your readers would only try Gravet's Rule they would soon find out that about two-thirds of the time spent in calculations would be saved.

The Slide Rule, in my opinion, is like electricity, still in its infancy, and its advantages have not yet been realised.

I think you, sir, would do well by bringing these Instruments more prominently before your readers, and thus not only act as the exponent of such a science as Electricity, but also be the means of introducing another time and labour saving instrument.

Thanking you very much for your courtesy,

Wm. Farrar.

41, Glover Street, Leeds,
3*rd Dec.*, 1883.

PATERSON & COOPER
(LATE EDWARD PATERSON),
ELECTRIC LIGHT & POWER & TELEPHONE ENGINEERS,
St. Paul's Works—76, LITTLE BRITAIN, LONDON, E.C., and
European Telegraph Works—POWNALL ROAD, DALSTON,
Prize Medals, International Electrical Exhibitions, Paris, 1881, and London, 1882.
MANUFACTURERS OF
THE ELPHINSTONE-VINCENT DYNAMO MACHINE.
THE LUMLEY DYNAMO MACHINE.
THE AYRTON & PERRY DYNAMO MACHINE.

Lumley Dynamo for 25 Incandescent Lamps	£50 0 0
" " 50 " "	75 0 0
Paterson & Cooper's "J.F." Arc Lamps	6 10 0

Manufacturers of the SIMPLEX SYSTEM of ARC and INCANDESCENT LIGHTING.
Manufacturers of the LEVER ARC LAMP.

Ayrton & Perry's Commutator Ammeter	£8 8 0
" " Non-Commutator Ammeter	6 6 0
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